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Forest Service

Tongass
National Forest

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Upper Carroll Timber Sale

Final Environmental Impact Statement

Volume I

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EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EVC	Existing/Expected Visual Condition
FEIS	Final Environmental Impact Statement
FSH	Forest Service Handbook
FSM	Forest Service Manual
GIS	Geographic Information System
IDT	Interdisciplinary Team
KPC	Ketchikan Pulp Company
KV	Knutsen-Vandenberg Act
LTF	Log Transfer Facility
LUD	Land Use Designation
LWD	Large Woody Debris (same as LOD)
MBF	One Thousand Board Feet
MELP	Multi-Entry Layout Process
MIS	Management Indicator Species
MM	Maximum Modification
MMBF	One Million Board Feet
NEPA	National Environmental Policy Act
NFMA	National Forest Management Act
NMFS	National Marine Fisheries Service
NOI	Notice of Intent
P	Primitive
PR	Partial Retention
R	Retention
RM	Roaded Modified
RN	Roaded Natural
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
SHPO	State Historic Preservation Officer
SPM	Semi-Primitive Motorized
SPNM	Semi-Primitive Nonmotorized
TLMP	Tongass Land Management Plan
TRUCS	Tongass Resource Use Cooperative Survey
TTRA	Tongass Timber Reform Act
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
VCU	Value Comparison Unit
VQO	Visual Quality Objective
WAA	Wildlife Analysis Area

Acknowledgments
Front cover: By Cindy Ross Barber, 1992. The design illustrates the range of interconnected issues addressed in the EIS.

Final Environmental Impact Statement

Upper Carroll Timber Sale

United States Department of Agriculture
Forest Service—Alaska Region

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Abstract

The USDA Forest Service proposes to harvest up to approximately 70 million board feet (MMBF) of timber in the Upper Carroll Project Area, Ketchikan Ranger District, Ketchikan Administrative Area, Tongass National Forest. Timber volume would be offered to the Ketchikan Pulp Company (KPC) under the KPC Long-term Timber Sale Contract (A10fs-1041) and/or the Ketchikan Area independent timber sale program. The actions analyzed in this EIS are designed to implement direction contained in the Tongass Land Management Plan (TLMP, 1979a, as amended) and the Tongass Timber Reform Act. The EIS describes 6 alternatives which provide different combinations of resource outputs and spatial locations of harvest units. The alternatives include: 1) No Action, proposing no new harvest from the Project Area at this time; 2) configure harvest units to provide the maximum amount of timber within Forest Plan Standards and Guidelines; 3) configure harvest units to emphasize timber sale economics, fisheries, wildlife, and subsistence values; 5) emphasize helicopter yarding in Neets Bay while allowing harvest at the Forest Plan implementation level in most other zones; 6) avoid harvest in Neets Bay and in potential goat winter range, minimize impacts to the west side of Carroll Creek through the use of helicopter logging; and 7) emphasize helicopter logging, visuals, and subsistence values.

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Purpose and Need

Outline

Chapter 1

Purpose and Need

Key Terms

Allowable Sale Quantity (ASQ)—the maximum quantity of timber that may be sold each decade from a National Forest.

Land Use Designation (LUD)—method of classifying land uses, allocated by the Forest Plan

MMBF—million board feet.

Management Area—an area for which management direction was written in the Forest Plan (TLMP 1979a, as amended 1986). Management areas encompass one or more Value Comparison Units (VCUs).

Offering—Forest Service specification of timber harvest units, subdivisions, roads, and other facilities and operations to meet the requirements of a contract.

Old-growth Forest—an ecosystem distinguished by old trees and related structural attributes. Old-growth forests encompass the latter stages of stand development. They typically differ from earlier stages of stand development in a variety of characteristics which may include tree size, accumulation of large dead woody material, number of canopy layers, tree species composition, and ecosystem function.

Primary Sale Area (PSA) and Contingency Area—the "sale area" designated in the long-term timber sale contract is composed of portions of Allotments E, F, and G. The sale area is often termed the "Primary Sale Area." The remainder of Allotments E, F, and G are often termed the "Contingency Area" for the contract. Allotments E, F, and G approximately correlate to the Ketchikan Administrative Area of the Tongass National Forest.

Scoping Process—activities used to determine the scope and significance of a proposed action, what level of analysis is required, what data is needed, and what level of public participation is appropriate.

Tongass Land Management Plan (TLMP)—the 10-year land allocation plan for the Tongass National Forest, also known as the Forest Plan. The TLMP was completed in 1979 and was amended in 1986 and again in 1991 (TLMP 1979a, as amended). The TLMP is currently undergoing revision; the Draft Environmental Impact Statement (DEIS) for the Proposed Revised Forest Plan was issued in 1990; a supplement to the TLMP Revision DEIS was issued in 1991 (TLMP Revision Supplement DEIS 1991a); and a Revised Supplement to the TLMP Revision Supplement DEIS was issued in 1996 (Revised Supplement Draft TLMP EIS 1996a). Reference in the Upper Carroll EIS to the Revised Supplement Draft TLMP EIS (TLMP RSDEIS, 1996a) is to the DEIS as proposed to be implemented in the Preferred Alternative of the Revised Supplement, unless otherwise noted. Until the Forest Plan Revision is completed, the TLMP (1979a, as amended) remains in effect.

Value Comparison Unit (VCU)—areas which generally encompass a drainage basin to provide a common set of areas where resource inventories could be conducted and resource interpretations made.

Introduction

In compliance with the National Environmental Policy Act (NEPA) and other relevant State and Federal laws and regulations, the Forest Service has prepared this Environmental Impact Statement (EIS) on the effects of timber harvest in the Upper Carroll Project Area (Figure 1-2) on Revillagigedo Island of the Ketchikan Administrative Area, Tongass National Forest. The proposed action would make up to approximately 70 million board feet (MMBF) of timber available to the Ketchikan Pulp Company (KPC) under its long-term timber sale contract with the Forest Service (Ketchikan Pulp and Paper Co. 1951, as amended in 1991), and/or the Ketchikan Area independent timber sale program. This EIS discloses the direct, indirect, and cumulative environmental impacts and any irreversible or irretrievable commitment of resources that would result from each proposed alternative.

Decision to be Made

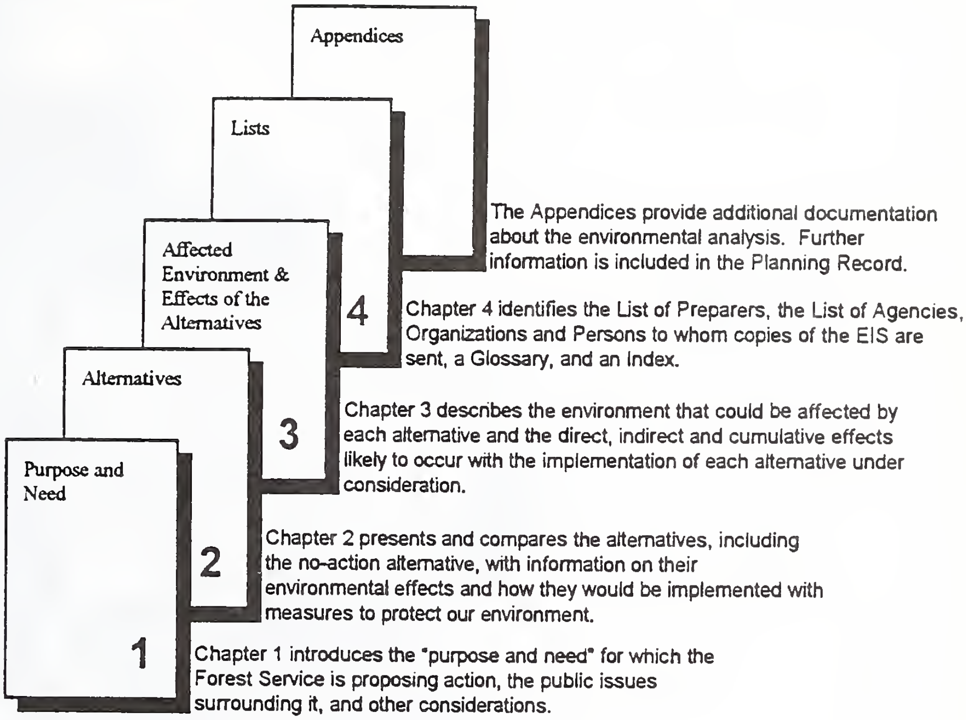
Based on the environmental analysis, the Ketchikan Area Forest Supervisor must decide whether or not and, if so, how to make timber available from the Upper Carroll Project Area in accordance with the implementation of the Tongass Land Management Plan (TLMP). The decisions will include:

- the volume of timber to make available in this area, in one or more timber offerings;
- the locations of timber harvest units;
- the locations of arterial and collector roads;
- necessary standards and guidelines, mitigation measures, and enhancement opportunities for sound resource management;
- whether there may be a significant restriction on subsistence uses.

Document Organization

This EIS is prepared according to the format (Figure 1-1) established by Council on Environmental Quality (CEQ) regulations (40 CFR 1500-1508) implementing NEPA. Chapter 1, in addition to explaining the purpose and need for the proposed action, discusses how the Upper Carroll Project relates to the Forest Plan and to other related NEPA actions, the key issues driving the EIS analysis, and the authorities guiding the EIS process. Chapter 2 describes and compares the alternatives for accomplishing the proposed action and no-action alternatives. Chapter 3 describes the potentially affected environment and the anticipated effects of the alternatives on the natural and human environment in the Project Area and those areas directly affected by the proposed action. Chapter 4 contains the list of preparers, distribution list, glossary, index, and cited literature. Finally, a series of appendices provides helpful references to understanding the EIS. Additional documentation may be found in the project Planning Record located at the Forest Supervisor's office in Ketchikan.

Figure 1-1
How This Document is Organized



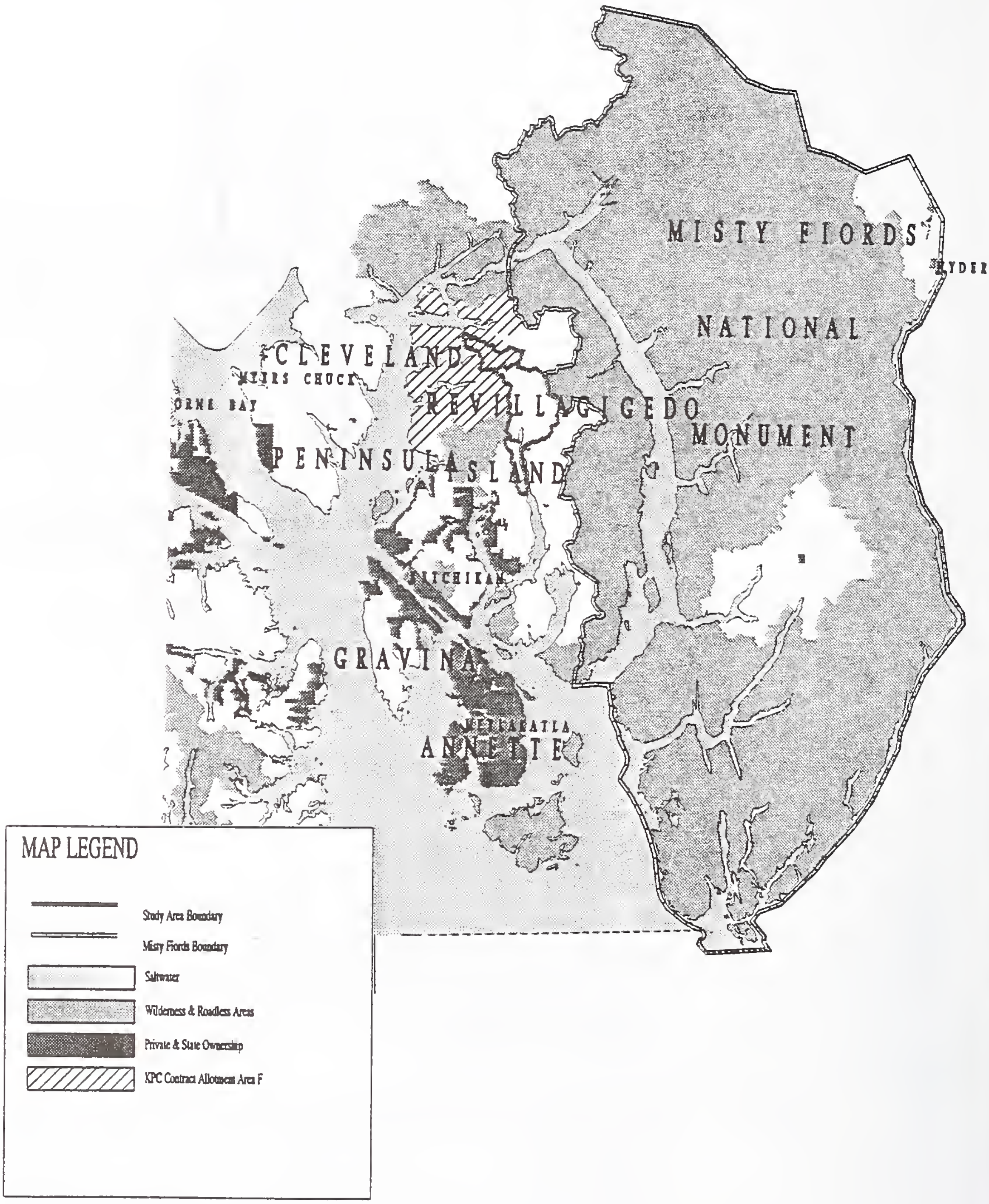
Project Area

The 47,942 acre Upper Carroll Project Area is located approximately 30 air miles northeast of Ketchikan, Alaska (Figure 1-2). It encompasses an area of north central Revillagigedo (Revilla) Island that extends from the head of Carroll Inlet north to Neets Bay. It includes the drainages associated with Neets Creek and Carroll Creek. There are no communities within or adjacent to the Project Area. Access to the Project Area is by small plane or boat generally originating in Ketchikan.

The Project Area includes TLMP 1979a, as amended) Management Area K32, West Revilla, and Management Area K35, Carroll-Thorne. The West Revilla Management Area includes Value Comparison Units (VCUs) 737 and 744. The Carroll-Thorne Management Area includes a portion of VCU 746 (Figure 1-3). VCU boundaries generally follow major watershed divides with a few minor exceptions. The Project Area is partially within the long-term contract Primary Sale Area; the remainder is within the long-term contract Contingency Area.

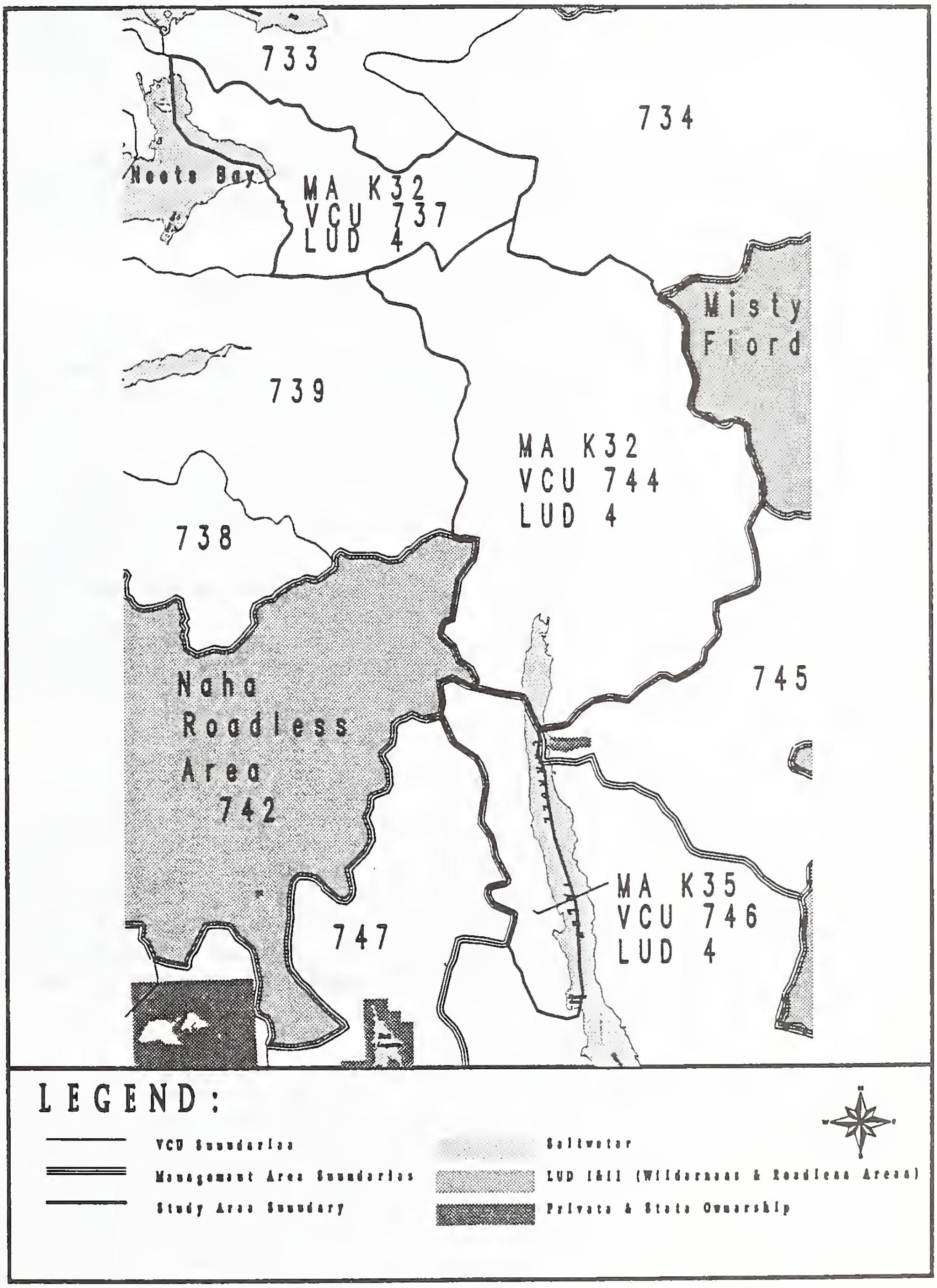
1 Purpose and Need

Figure 1-2
Project Area Vicinity Map



The 47,997-acre Project Area is located approximately 30 miles northeast of Ketchikan. It encompasses an area of northcentral Revillagigedo (Revilla) Island, from the head of Carroll Inlet north to Neets Bay.

Figure 1-3
Management Area and VCU Boundaries



Proposed Action

The proposed action would harvest up to approximately 70 MMBF of timber from an estimated 2,000 acres through a series of offerings beginning in 1996. Timber sale offerings from this harvest will be made available to KPC or the Independent Timber Sale Program. As many as 61 miles of new road would be built to facilitate timber removal. Two existing log transfer facilities (LTFs) and one newly constructed facility would be utilized to implement the action alternatives.

The proposed action is consistent with implementation of the Forest Plan known as the Tongass Land Management Plan (TLMP 1979a, as amended), thereby moving from the existing forest condition toward the desired future condition.

Purpose and Need

The purpose and need for this project is to implement direction contained in the Tongass Land Management Plan (TLMP 1979a, as amended), to help provide a sustained level of timber supply to meet annual and TLMP planning cycle market demand, and to provide local employment in the woods products industry, consistent with providing for the multiple use and sustained yield of all renewable forest resources. Another objective would be to provide timber volume that will contribute to a three-year current timber supply under the KPC long-term timber sale contract (No. A10fs-1042; Sections B0.61 and B0.62) and/or the Ketchikan Area Independent Timber Sale Program. The alternatives and actions considered are possible approaches to meeting this purpose and need. The EIS study process was designed to help insure that, in meeting this purpose and need, the Forest Service makes the most informed decision possible for this Project Area specifically, and for the Tongass National Forest generally. The Upper Carroll Project is expected to provide up to approximately 70 MMBF of timber, given the guidance of the Forest Plan.

Implement TLMP

The Project Area is partially within the long-term contract Primary Sale Area; the remainder is within the Contract Contingency Area. Under TLMP, 100 percent of the Project Area has been given Land Use Designation (LUD) IV. The TLMP schedules timber sale preparation for all Management Areas in the Project Area. A comparison of the Desired Future Condition for the Project Area, as reflected in TLMP direction, with the existing condition shows the need to convert suitable stands of old growth to managed productive stands capable of long-term timber production.

Timber Demand

Section 101 of the Tongass Timber Reform Act of 1990 (TTRA), directs the USDA Forest Service ''... to the extent consistent with providing for the multiple use and sustained yield of all renewable forest resources, seek to provide a supply of timber from the Tongass National Forest which (1) meets the annual market demand for timber from such forest and (2) meets the market demand from such forest for each planning cycle.'' Section 101 of the TTRA specifies that Forest Service efforts to seek to meet market demand are subject to appropriations, National Forest Management Act (NFMA) requirements, and other applicable laws. Providing a timber supply from the Tongass for sustained local wood products industry employment and related economic and social benefits is an objective of the TLMP, the Alaska National Interest Land Conservation Act (ANILCA), as amended by the TTRA, and the long-term contract.

There is demonstrated mill capacity in the region to process logs, if a supply of timber is available. There is also a projected need for the timber volume being considered from this Project Area for the Forest Service to come closer to meeting an objective of providing a three-year supply of timber under contract to the existing dependent industry (see Appendix A), as a means of providing for stability in relation to fluctuating market demand (Morse, 1995). There is a substantial component of the economy of Southeast Alaska that is dependent on a viable timber industry. Based on these factors, the need for the project is clearly indicated.

Reasons for Scheduling the Environmental Analysis of the Upper Carroll Project Area

Reasons for scheduling the Upper Carroll Project Area at this time, for detailed consideration of timber harvest under the long-term timber sale contract between Ketchikan Pulp Company (KPC) and the Forest Service (Contract No. A10fs-1042) and/or under independent timber sales, may be summarized as follows:

- The Upper Carroll Project Area contains a sufficient amount of harvestable timber volume designated as LUD III or IV, and is therefore appropriate for harvest under the Tongass National Forest Land Management Plan (TLMP). Available information indicates harvest of the amount of timber being considered for this project can occur consistent with TLMP standards and guidelines and other requirements for resource protection. Analysis also indicates harvest of the amount of timber being considered can occur consistent with the proposed TLMP standards and guidelines and other resource protection requirements.

- Areas with available timber both inside and outside the designated long-term contract sale area will be necessary for harvest in order to meet timber supply requirements under the contract. The Upper Carroll Project Area is partially within the long-term timber sale contract Primary Sale Area; the remainder is within the contract contingency Area. The contract requires the Forest Service to look first to the designated sale area for timber to meet the contract's supply requirements before offering timber outside that area.

- Areas with available timber both within and outside the designated sale area will also be necessary to consider for harvest in order to seek to provide a supply of timber from the Tongass National Forest which (1) meets the annual market demand for timber from such forest and (2) meets the market demand from such forest for each planning cycle, pursuant to Section 101 of the Tongass Timber Reform Act (TTRA).

- Effects on subsistence resources are projected to differ little according to which sequence these areas are subjected to harvest. Harvesting other areas on the Tongass National Forest with available timber is expected to have similar potential effects on resources, including those used for subsistence because of widespread distribution of subsistence use and other factors. Harvest of these other areas is foreseeable, in any case, over the forest planning horizon under either the existing or proposed revised TLMP.

- Providing substantially less timber volume than required by the long-term contract with KPC and/or to meet TLMP and TTRA Section 101 timber supply and employment objectives in order to avoid harvest in the Upper Carroll Project Area or other project areas would not meet contract requirements and is otherwise not necessary or reasonable.

- It is reasonable to schedule harvest in the Upper Carroll Project Area at the present time rather than other areas in terms of previous harvest entry and access, level of controversy over subsistence and other effects, and the ability to complete the National Environmental Policy Act (NEPA) process and make timber available to meet long-term contract requirements by the time it is reasonably necessary to do so. Other areas that are reasonable to consider for harvest in the near future are the subject of other project EISs that are currently ongoing or scheduled to begin soon.

Additional information about why the Upper Carroll area was selected is provided in Appendix A.

Appendix A was revised for the FEIS to present the latest projections of demand for timber supply and it addresses the projected need for timber supply from outside the Primary Sale Area. The updating of the Appendix A information does not result in a different conclusion regarding the purpose and need for the Upper Carroll Sale. The changes to these sections are not so substantial in light of environmental concerns or range of alternatives as to require supplementation of the EIS.

Existing and Desired Future Condition

The existing condition of the Project Area is described in Chapter 3 of this EIS, in the "Affected Environment" portion of each resource section. The Neets Bay valley bottom was extensively logged from the 1950s through the 1960s. A moderate amount of timber harvest occurred inside the Project Area at the head of Carroll Inlet in the 1970s. Currently the Shelter Cove timber sale is harvesting timber near North Saddle Lakes in VCU 746. With the exception of the Shelter Cove harvesting, the majority of the second growth is fully stocked, 20-40 years old and 20-50 feet tall. The Project Area contains 21,706 acres of commercial forest land, of which 17,641 acres of old-growth remain. Recreation use within the Project Area focuses on water related activities. Known land-based subsistence use has been low.

The desired future condition, as specified in the Management Direction/Emphasis for each management area, was established through the Forest planning process and is presented in the TLMP, (1979a, as amended). This management direction contained goals for timber, recreation, visuals, fish, wildlife, and other resources. It is anticipated that more than half of the Forest will remain in a basically unmodified state over time, if current land use designations remained the same. For specific management emphasis and direction for each management area in the Upper Carroll Project Area, see TLMP as amended in 1985-86 (USDA Forest Service 1986, Doc. 147).

The management emphasis and direction was further refined as the Desired Future Condition in the TLMP Draft Revision. This desired future condition consists of a mosaic of timber stands of varying sizes and ages, interspersed with areas of old growth and nonforest vegetation, furnishing a sustained yield of timber in balance with other resources and uses.

Achievement of the desired future condition as described in the TLMP RSDEIS (1996a) will require many decades. It will be reached by applying integrated resource management practices that are responsive to site specific, on-the-ground conditions. Roaded access would be provided for suitable timber lands. Harvested old-growth timber sites will be converted to successive stands of younger trees which will produce higher average volumes per acre than existing stands. Timber, including saw logs and utility volume, will have contributed to the Forest allowable sale quantity (ASQ).

Riparian areas will be managed to benefit riparian dependent resources. Water quality will continue to meet or exceed state standards. Fish habitat conditions will be maintained or improved. Sensitive visual resources, particularly as viewed from saltwater, will be consistent with the proposed visual quality objectives (VQOs).

Recreation opportunities will continue to be associated with float plane and boat access from saltwater. Primitive recreation opportunities will be reduced, but dispersed and developed recreation opportunities associated with roads will be maintained or improved.

Old-growth stands will be reduced in the Project Area but unsuitable lands, beach fringe, estuary, and stream protection zones, in addition to Orchard Lake and adjacent large blocks of old growth (Misty Fiords National Monument and Naha Roadless Area), will be retained. Old-growth associated species such as hairy woodpecker, marten, Vancouver Canada goose, river otter, and Sitka black-tailed deer will continue to be adequately represented. Management may be adjusted to accommodate any verified use of the area by threatened, endangered, and sensitive species in accordance with recovery habitat maintenance and objectives.

The Decision Making Process

National Forest planning involves several levels of decision. Decision making begins with long-range planning at the national level, continuing down through the regional and forest levels to the project level. The Upper Carroll Project is part of this process. This EIS is a project-level analysis; as such, it does not attempt to address decisions made at higher levels. It does, however, implement direction provided at those higher levels. Specifically, the Upper Carroll Project would implement direction in the Forest Plan (TLMP, 1979, as amended).

National Level

The 1990 Program and Assessment, as directed by the Forest and Rangeland Renewable Resources Planning Act of 1974 (Resources Planning Act) as amended, provides national direction for resource allocations and targets. An assessment of the forest and rangeland renewable resources is required every ten years, and development of a program for managing those resources is required every five years. The Resources Planning Act program provides Congress with a basis to link annual budgets with long-term resource needs.

Regional Level

The Alaska Regional Guide EIS (1983), addressed regional issues specific to Alaska, established management standards and guidelines, and displayed resource outputs for the Tongass National Forest. The Forest Plan takes into account this regional direction.

1 Purpose and Need

Forest Level

The National Forest Management Act of 1976 (NFMA) directs each National Forest to prepare an overall plan of activities. The Forest Plan provides land and resource management direction for the Forest. It establishes LUDs to guide management of the land for certain uses. The LUDs describe the activities that may be authorized within the Value Comparison Units (VCUs), the boundaries of which usually follow easily recognizable (major) watershed divides.

For the Tongass National Forest, the Forest Plan is the Tongass Land Management Plan (TLMP) of 1979, as amended in 1986, and again in February 1991, as a result of the Tongass Timber Reform Act (TTRA). The Forest Plan is currently undergoing revision, as required by the NFMA. A supplement to the TLMP Draft EIS was issued in 1991 (USDA Forest Service 1991a). A Revised Supplement to the 1991 SDEIS was issued in 1996 (USDA Forest Service 1996a). Until the Record of Decision (ROD) for the Revision is signed, the TLMP (1979a, as amended) remains in effect.

Project Level

Other Projects

The North Revilla EIS was the most recent EIS addressing the KPC Long-term Contract within portions of the Project Area. It provided 197 MMBF of timber of which 168 MMBF was offered; the remainder was deferred from harvest for a variety of reasons (see North-Revilla Unit Change Analysis - Ketchikan Ranger District Timber Files). None of the selected North Revilla ROD harvest units were located within the Upper Carroll Project boundary.

The 1984-89 Long-term Sale Contract EIS (LTS EIS) was the most recent 5-year operating plan for the KPC Long-term Contract which addressed timber harvest on Revillagigedo Island. It provided 54 MMBF, all outside the Upper Carroll Project Area, and all harvest is complete.

The Shelter Cove EIS cleared 66 MMBF in May 1991. A small portion of this project, located near North Saddle Lakes (VCU 746), overlaps the current Upper Carroll Project Area. All of the Shelter Cove units located within the Upper Carroll Project Area have been harvested at this time.

The Swan Lake-Lake Tyee Powerline Intertie Project has been proposed by Ketchikan Public Utilities (KPU). KPU has contracted with Foster Wheeler Environmental Corporation in the preparation of an Environmental Impact Statement for this project. The analysis for this project is currently underway. The DEIS was published in March 1996 and a Final Environmental Impact Statement (FEIS) is anticipated by the fall of 1996.

Current Project

The Upper Carroll EIS presents a broad range of alternatives and displays site-specific descriptions and impacts of the proposed activities of six alternatives.

This EIS is "tiered" to the TLMP EIS 1979a, as amended in 1986 and 1991 as permitted by 40 CFR 1502.20.

This EIS also tiers to the Alaska Regional Guide EIS, 1983.

Relevant discussion from the following documents has been incorporated by reference rather than repeated (40 CFR 1502.21):

This EIS proposes management consistent with the TLMP RSDEIS (1996a), Preferred Alternative. Documented forest-wide analyses in TLMP (1979, as amended) or the TLMP RSDEIS (1996a) are referenced rather than repeated in this EIS.

This EIS makes no recommendations for site-specific amendments to the Forest Plan in the form of land allocations to provide old-growth habitat conditions or management for visual quality. Such decisions are made by the Forest Plan.

The Interdisciplinary Team (IDT) used a systematic approach to analyze the proposed project, estimate the environmental effects, and prepare this EIS. The planning process complies with the National Environmental Policy Act (NEPA). Planning was coordinated with affected Federal, State, local agencies, and local federally recognized tribes.

TLMP, as Amended

Land Use Designations

The current TLMP (1979a, as amended) designates areas appropriate for various activities through four Land Use Designations (LUD). The proposed TLMP RSDEIS (1996a) would provide more specific management direction by subdividing the Project Area into refined LUDs and by applying specific standards and guidelines. This EIS also utilizes the standards and guidelines presented in the TLMP RSDEIS (1996a).

The Upper Carroll Project Area is allocated to LUD IV as described below. Full definitions of all LUDs are presented in the current TLMP (1979a, as amended).

LUD IV

Areas allocated to LUD IV provide opportunities for intensive development of resources. Emphasis is primarily on commodity or market resources and their uses. Amenity values are also considered. When conflicts regarding competing resource use arise, resolution most often would be in favor of commodity values. Allowances in calculated potential timber yields have been made to provide for protection of physical and biological productivity. Specifics include:

- Timber is to be harvested primarily by clearcutting;
- Potential timber yields are to be reduced only to the extent necessary to protect the biological and aesthetic values;
- Mineral development is subject to existing laws and regulations;
- Permanent or temporary roads may be built;
- Motorized use is permitted;
- A full range of recreational facilities is permitted;
- A full range of fisheries improvement projects are permitted; and
- Needed trails can be provided.

The Project Area contains 47,942 acres of LUD IV lands in VCUs 737, 744 and 746.

TLMP Revision

The TLMP RSDEIS (1996a) would refine the Land Use Designations. For example the existing LUD IV lands along the head of Neets Bay and Carroll Inlet would be managed as Modified Landscapes (ML). The TLMP RSDEIS supplements management direction through detailed management prescriptions and standards and guidelines. There are 19 LUDs identified in the TLMP RSDEIS, four of which apply to the Upper Carroll Project Area. References in this document to the TLMP RSDEIS will mean the Preferred Alternative of the Revised Supplement Draft Tongass Land Management Plan EIS (1996a) unless otherwise noted. The TLMP RSDEIS LUDs and other land ownerships allocated in the Project Area are described below.

Alaska State Lands (AK)
Lands belonging to the State of Alaska. None are located within the Project Area.

Private Lands (PV)
No privately owned lands are located within the Project Area.

Encumbered Lands (EN)
This is not a designated LUD in the TLMP RSDEIS. However, for purposes of this EIS, it designates areas within the Upper Carroll Project Area which have been selected but not yet conveyed to the State or to Native corporations and are not considered in the action alternatives of this project.

Old-Growth Habitat
Manage the area to maintain a diversity of old-growth conifer habitats in their natural condition to favor old-growth associated fish and wildlife species. No timber harvesting will be scheduled and roads will be located outside the area when possible.

Scenic Viewshed
Management activities are not visually apparent to the casual observer in the near distance from visual priority travel routes and use areas. In the middle to background distance, activities are subordinate to the landscape character of the area. Timber harvest is allowed and roads are permitted.

Modified Landscape
Manage for a variety of uses. Management activities are subordinate to scenic quality as seen in the near distance. In the middle to background distance, activities may dominate but are designed to be compatible with features found in the characteristic landscape. Timber harvest is allowed and roads are permitted.

Timber Production
Manage the area to maintain and promote industrial wood production. These lands will be managed to advance conditions favorable for the timber resource and for long-term timber production. Roads are permitted.

Table 1-1 displays the Management Areas and management prescriptions within the Project Area, the VCUs, and the corresponding acres associated with each Land-Use Allocation. Figure 1-4 displays the location of the TLMP RSDEIS (1996a) proposed land allocations within the Upper Carroll Project Area.

Table 1-1
Land Use Designations as Defined in TLMP RSDEIS (1996a)

Management Area	VCU	ML	TM	SV	OG	EN	Total Acres
K32	737	2,407	5,026	0	0	1,722	9,155
K32	744	2,785	27,398	0	1,449	0	31,632
K35	746	3,352	1,027	113	0	0	4,492
Total Acres Excluding Saltwater		8,544	33,451	113	1,449	1,722	45,279

ML—Modified Landscape
TM—Timber Production
SV— Scenic Viewshed
OG—Old-growth Habitat
EN—Encumbered
AK & PV—Alaska State and Private Lands, none in Project Area.

Note: Discrepancies may be found between tables due to rounding

Figure 1-4
Upper Carroll Project Area Land Allocations as proposed in TLMP RSDEIS (1996a)

Public Involvement

Scoping

The NEPA process (40 CFR 1501.7) was used to determine the scope of the issues to be addressed and identify major concerns related to the proposed action. The scoping process was used to invite public participation and collect initial comments. The public was invited to comment on the project through the following process.

Notice of Intent (NOI)

A Notice of Intent was published in the Federal Register on August 31, 1994, when it was decided that an EIS was to be completed for the project.

Public Mailing

On August 30, 1994, a letter providing information and seeking public comment (scoping document) was mailed to approximately 1,200 individuals and groups that had previously shown interest in Forest Service projects in Southeast Alaska. The mailing included eight Federal agencies, 18 State agencies and divisions, 67 Native and municipal offices, and 213 businesses and other organizations and groups, in addition to individual citizens. Approximately 101 responses to this initial mailing were received.

Local News Media

Announcements about the project were printed in the *Ketchikan Daily News*, *Island News*, *Wrangell Sentinel*, *Sitka Sentinel*, *Petersburg Pilot*, and *Juneau Empire*. A scoping document describing the project was placed in the September 3, 1994 weekend edition of the *Ketchikan Daily News*. A press conference was held September 12, 1994, to discuss current planning projects on the Ketchikan Area of the Tongass National Forest, including the Upper Carroll EIS.

Briefings

Additional briefings were held to provide information and clarification on issues and alternatives from October 1994 through May 1996 with individuals and organizations. Consultation with local, state, federal, and local tribal government agencies also occurred during this time.

Draft EIS

Availability of Draft EIS for Public Comment

Availability of the Draft EIS was announced in the Federal Register on January 26, 1996, with a deadline for public comment listed as March 11, 1996. Documents were mailed to the Distribution List in January 1996.

A news release was issued on January 16, 1996, which resulted in an article regarding the Upper Carroll EIS and upcoming hearing dates in the Ketchikan Daily News on January 20, 1996. Additional announcements concerning Open Houses and Subsistence Hearings were sent to local radio stations on February 20, 1996. The Meetings and Brevities section of the Ketchikan Daily News announced the hearing dates and locations on February 21 and 22, 1996.

Subsistence Hearings

Subsistence hearings were held in Ketchikan, Cape Fox Lodge, February 22, 1996, and Saxman, Saxman City Hall, February 23, 1996. Announcement of the times and locations of the hearings was included in the letter accompanying every document and was announced by public media as described above. Comments were recorded. Open houses to describe the analysis process and answer public questions were held in conjunction with the subsistence hearings.

Final EIS

Response
Approximately 373 individuals, agencies, and organizations submitted written comment on the Upper Carroll DEIS. In addition, nine verbal testimonies were received at the two subsistence hearings. The 45-day comment period officially closed March 11, 1996; however, all letters were accepted and the comments were analyzed and incorporated into the FEIS as appropriate.

The FEIS has been filed with the Environmental Protection Agency and is available to the public.

For a complete analysis of public comment and the Forest Service response to public comment, see FEIS Appendix L.

Copies of the legal notices and newspaper articles, as well as comments received, are included in the project Planning Record.

Issues

Issues Associated with the Proposed Action

The significant public issues, management concerns, and resource opportunities identified through the public and internal scoping process were used to formulate issues statements. Some of these issues were raised by the public, and some reflect Forest Service concerns. Similar issues and concerns were grouped when appropriate.

Issues 1 through 8 were determined to be significant and within the scope of the project. All these issues will be addressed in all alternatives. Issues A-H were considered but eliminated from detailed study because their resolution falls outside the scope of the Upper Carroll project.

Issue 1: Timber Economics and Supply
The issue encompasses public concern with the amount of timber available and proposed for harvest, methods of timber harvest, whether timber harvest should be continued, and balancing timber production with other Forest uses. It includes the issue of how the Project Area contributes to the long-term timber supply. It also includes concern for ensuring cost-effective timber harvest.

Issue 2: Fish Habitat and Water Quality
This issue addresses public concern for maintaining water quality in streams which provide suitable habitat for anadromous and resident fish. Fish and shellfish within the Upper Carroll Project Area are important to sport, commercial, and subsistence users throughout Southeast Alaska. The Southern Southeast Regional Aquaculture Association (SSRAA) operates a fish hatchery at Neets Bay under special use permit from the Forest Service. This issue also includes concerns about timber harvesting on steep slopes, mass movement of soil, stream temperature sensitivity, as well as karst and cave protection.

Issue 3: Recreation and Scenic Quality
Forest management activities could affect existing recreational pursuits for users of the Upper Carroll Project Area. More specifically, increased human access, timber harvest, and other developments could affect recreation values and opportunities including: hunting, fishing, scenic quality, and recreation use areas. Comments mentioned the importance of protecting the scenic quality along inlets and bays. Other aspects of this issue were related to the visual impacts to flight-seeing, the visual appearance along the proposed intertie route, and potential impacts, if any, to Misty Fiords National Monument.

Issue 4: Wildlife

This issue includes concerns over several wildlife species and the habitats critical to the maintenance of those wildlife populations; Alaskan wildlife is valuable for aesthetic, economic, recreational, ecological, and subsistence purposes. Of primary concern are the effects of timber harvest and associated road construction upon wildlife species dependent on old-growth habitat. There is also a concern regarding the proportion of Volume Classes 6 and 7 remaining after harvest in each management area. The long-term disposition of previously mapped old-growth areas (commonly referred to as retention areas) in the Project Area was identified as part of this issue. Related to the overall concern is the question of whether timber harvest operations would further fragment existing large blocks of old-growth habitat and result in declines in biological diversity. The need for a project specific old-growth habitat strategy that ties into a larger scale habitat strategy was also identified.

Issue 5: Subsistence

Primary concern is the potential effect, as well as the cumulative effects, of timber harvest and road construction upon the abundance and distribution of subsistence resources. For many, subsistence consists of hunting, fishing, trapping, and gathering to supplement their food sources, income, and other needs. For Southeast Alaska's Natives, it is a way of life directly related to preserving their culture and traditions. The Alaska National Interest Lands Conservation Act (ANILCA) specifically requires the Forest Service to determine if the proposed activities may significantly restrict subsistence use. Other aspects to be evaluated are competition from non-rural subsistence users and access to the resources.

Issue 6: Transportation/Utility Corridor

The State of Alaska (Alaska Energy Authority) recently completed a feasibility study for the utility/transportation corridor located partially within the Project Area. Ketchikan Public Utilities has awarded a contract to Foster Wheeler Environmental Corporation to complete an EIS for the proposed electrical intertie from Swan Lake to Lake Tyee. The Swan Lake-Lake Tyee Draft EIS was published in March 1996. The preliminary preferred route includes approximately 30 to 40 miles within the Upper Carroll EIS study area. The two proposed actions appear to be similar actions (40CFR 1508.25) because of the potential road locations, common timing, and geography. The degree to which each alternative could contribute to a potential transportation/utility link will be documented in the EIS.

Issue 7: Social and Economic Effects

This issue reflects concerns about effects on community employment and income, population, community stability, and lifestyles. The economies of most communities in Southeast Alaska depend almost exclusively on the Tongass National Forest to provide natural resources for uses such as fishing, tourism, recreation, timber harvesting, mining, and subsistence. Many Southeast Alaskans want to maintain the natural environment which makes their lifestyle unique. At the same time, they want to continue maintaining their economic livelihood.

Issue 8: Marine Environment

The marine waters and their associated mud flats and estuaries found in protected coves and bays within the Project Area provide habitat for species such as Dungeness crab and juvenile salmon. Since coves and bays are the points of concentrated activity associated with marine transport of logs, logging camps, and sort yards, some marine species are subject to effects from log transfer and storage facilities. Four potential or existing LTF sites are under consideration in the alternatives.

Issues Outside the Scope of This Analysis

The following public issues were considered but eliminated from detailed study because their resolution is beyond the scope of this document.

Issue A: Land Use Designations/Forest Plan Revision

This issue focuses on the stated desire of some commenters to change TLMP Land Use Designations to eliminate, reduce, or increase the level of harvest and/or maximize specific resources.

Land use allocation is a Forest planning issue. The current Forest Plan is under revision and provides a forum for people who wish to see the area managed in a manner that differs from the current direction.

Issue B: Bradfield Road Transportation Link

Some members of the public expressed a concern that the Bradfield Road Transportation Link be evaluated in whole or in part in this EIS.

The Bradfield road connection (excluding Revillagigedo Island) is not a connected or reasonably foreseeable action that is ripe for a decision. The portion of the proposed transportation link located within the Project Area that could be influenced by the proposed activities will be addressed.

Issue C: Development Outside the Project Area

Comments regarding the general level of development outside the Project Area are not considered issues ripe for decision under the Upper Carroll EIS. These areas include Cleveland Peninsula, Prince of Wales Island, and Orchard Creek (including Orchard Lake).

Issue D: Below Cost Timber Sales

Below cost timber sales are a national issue and not within the scope of this project. The financial impacts of the alternatives, based on a mid-market analysis, are displayed in Chapter 3 in this EIS.

Issue E: Timber Supply and Demand

Timber supply and demand is a regional issue and exceeds the scope of this analysis. A site-specific environmental analysis documents the effects of the proposed activities; it does not constitute the selling or conveyance of property rights. The volume of timber cleared in any NEPA document may be offered (sold) in part, in whole, or not at all.

The timber offered for sale (timber offerings) may occur in one year or be spread over a three- to five-year period. Therefore, trying to predict the effects of the proposed activities upon the regional timber supply or demand is beyond the capability and scope of this document beyond concluding that timber offerings that implement the project will contribute volume to the timber supply and help meet demand.

The issue of how the Project Area contributes to the long-term timber supply is addressed as part of Issue 1: Timber Economics and Supply.

Issue F: Manage Upper Carroll for Sustained Yield

The National Forest Management Act (NFMA) directs that a sustainable level of harvest be identified for each National Forest. A sustainable level of harvest is one in which the level of harvest is equal to or less than the rate of growth over a period of time (ten years in the case of NFMA). There is no direction or intent to establish a sustainable level of harvest for individual Project Areas or small geographic subdivisions of the Forest.

Issue G: Wild and Scenic Rivers

Several comments were received requesting that Carroll Creek be managed as a Wild and Scenic River. This is a Forest Planning issue. Carroll Creek was thoroughly analyzed for Wild and Scenic River eligibility as a part of previous Forest Planning efforts. Carroll Creek was analyzed as part of the TLMP Revision to determine if it was eligible to be included under the Wild and Scenic Rivers Act. That analysis determined that no segment of Carroll Creek was eligible for inclusion under the Wild and Scenic Rivers Act.

Issue H: Cancel the KPC Long-term Sale Contract

The issue of cancelling the KPC Long-term Sale Contract is outside the scope of this project. The No Action alternative is considered in detail in both the DEIS and FEIS. Cancelling the contract would not serve the purpose and need for the project.

Federal and State Permits, Licenses, and Certifications

To proceed with the timber harvest as addressed in this EIS, various permits must be obtained from Federal and State agencies. Administrative actions on these permits would be initiated after the EIS is filed with the Environmental Protection Agency (EPA). The agencies and their responsibilities are listed below.

U.S. Army Corps of Engineers

- Approval of discharge of dredged or fill material into waters of the United States (Section 404 of the Clean Water Act of 1977, as amended).
- Approval of construction of structures or work in navigable waters of the United States (Section 10 of the Rivers and Harbors Act of 1899).

U.S. Environmental Protection Agency

- Storm water discharge permit.
- National Pollutant Discharge Elimination System review (Section 402 of the Clean Water Act).

State of Alaska, Department of Natural Resources

- Authorization for occupancy and use of tidelands and submerged lands.

State of Alaska, Department of Environmental Conservation

- Certification of compliance with Alaska Water Quality Standards (Section 401 Certification).
- Solid Waste Disposal Permit (Section 402 of the Clean Water Act).

U.S. Coast Guard

- Coast Guard Bridge Permit (in accordance with the General Bridge Act of 1946) required for all structures constructed across navigable waters of the U.S.

Legislation and Executive Orders Related to This EIS

Shown below is a brief list of laws pertaining to preparation of EISs on Federal lands. Some of these laws are specific to Alaska, while others pertain to all Federal lands.

- National Historic Preservation Act of 1966 (as amended)
- Wild and Scenic Rivers Act of 1968, amended 1986
- National Environmental Policy Act (NEPA) of 1969 (as amended)
- Clean Air Act of 1970 (as amended)
- Alaska Native Claims Settlement Act (ANCSA) of 1971
- Marine Mammal Protection Act of 1972
- Endangered Species Act (ESA) of 1973 (as amended)
- Forest and Rangeland Renewable Resources Planning Act (RPA) of 1974 (as amended)
- National Forest Management Act (NFMA) of 1976 (as amended)
- Clean Water Act of 1977 (as amended)
- American Indian Religious Freedom Act of 1978
- Alaska Native Interest Lands Conservation Act (ANILCA) of 1980
- Archeological Resource Protection Act of 1980
- Cave Resource Protection Act of 1988
- Tongass Timber Reform Act (TTRA) of 1990
- Executive Order 11988 (floodplains)
- Executive Order 11990 (wetlands)
- Executive Order 11593 (cultural)
- Executive Order 12962 (aquatic systems and recreational fisheries)

In addition, the Coastal Zone Management Act (CZMA) of 1976, as amended, pertains to the preparation of an EIS. Federal lands are not included in the definition of the coastal zone as prescribed in the CZMA. However, the act requires that when Federal agencies conduct activities or development that affect the Coastal Zone, that agency's activities or development be consistent to the maximum extent practicable with the approved State Coastal Management Program. This determination is made by the U.S. Forest Service.

The Alaska Coastal Management Plan incorporated the Alaska Forest Resources and Practices Act of 1979 as applied standards and guidelines for timber harvesting and processing. The Forest Service Standards and Guidelines and Mitigation Measures described in Chapter Two of this document are equal to or exceed State Standards.

Availability of the Planning Record

An important consideration in preparation of this EIS has been reduction of paperwork as specified in 40 CFR 1500.4. In general, the objective is to furnish enough site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternatives and how these impacts can be mitigated.

The Planning Record is available upon issuance of the EIS at the Forest Supervisor's office, Ketchikan, Alaska. Other reference documents such as the Tongass Land Management Plan (TLMP, as amended 1979a), the Revised Supplement Draft Tongass Land Management Plan EIS (TLMP RSDEIS, 1996a), the Tongass Timber Reform Act, the Resources Planning Act, and the Alaska Regional Guide EIS, are available at public libraries around the region as well as at the Supervisor's Office in Ketchikan.

Chapter 2

Alternatives

Outline

Chapter 2

Alternatives

Key Terms

Alternative—one of several policies, plans, or projects proposed for decision making.

BMPs—Best Management Practices - practices used for the protection of water quality.

Desired Future Condition—concise statement that describes a desired condition to be achieved sometime in the future. It is normally expressed in broad, general terms and is timeless in that it has no specific date by which it is to be completed.

FTE—Full Time Equivalent.

Large Old Growth Blocks—contiguous blocks of wildlife habitat to be managed and conserved for breeding pairs, connectivity, and distribution of species of concern.

Implementation monitoring—collecting information to evaluate whether mitigation measures were carried out in the manner called for.

Logging System Transportation Analysis (LSTA)—interdisciplinary design and mapping of all potential timber harvest units, including associated logging and transportation systems.

Mitigation—measures designed to counteract or lessen environmental impacts.

MMBF—a million board feet.

Partial cut—harvest of timber using silvicultural prescription other than clearcut; examples include shelterwood, seed tree, and group selection.

Roadless area—an area of undeveloped public land identified by the March 1996 Revised Supplement Draft Tongass Land Management Plan EIS (RSDEIS, 1996a) within which there are no improved roads maintained for travel by means of motorized vehicles intended for highway use.

Subsistence—the customary and traditional uses by rural Alaskan residents of wild renewable resources for direct personal or family consumption.

Windfirm—individual trees that are able to resist windthrow or the configuration of harvest units so as not to create an opening which exposes the adjacent stand of timber to the direction of the major prevailing storm wind (southeast).

Introduction

Chapter 2 summarizes the development of alternative actions for making timber available to the local forest products industry, while implementing the Tongass Land Management Plan (TLMP 1979a, as amended) in the Upper Carroll Project Area. It also discusses the alternatives considered but eliminated from detailed study. Finally this chapter explains and compares the six alternative actions selected for detailed study. Chapter 2 is intended to present the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decision maker and the public (40 CFR 1502.14).

Much of the information in Chapter 2 is summarized from Chapter 3, Environment and Effects. Chapter 3 contains the detailed scientific basis for establishing a baseline and measuring the environmental consequences for each of the alternatives. For the best understanding of the six alternatives, readers should consult Chapter 3.

Changes Between DEIS and FEIS

There has been a refinement in the site-specific information available for analysis in the Final Environmental Impact Statement (FEIS), compared to what was available at the time the Draft Environmental Impact Statement (DEIS) was published. Refined information has been incorporated into the FEIS in order to make the proposed harvest units more site specific, as well as to make the units selected for each alternative more closely align with the alternative theme. The unit cards in Appendix K, display the unit configuration, layout direction, and mitigation measures that apply to each unit.

New Information

There are five general sources of improved information:

- Additional Forest Service field reconnaissance;
- Public response to the DEIS (approximately 382 responses: see Appendix L);
- Subsistence hearings in Ketchikan and Saxman communities;
- Geographic Information System (GIS) information used in the analysis was updated to reflect new information or increased accuracy:
- Classification of previously unclassified streams. This information was incorporated into the unit configuration, mitigation and analysis (Watershed Report - Appendix F). The updated streams are depicted on the unit cards.

Improved Analysis

In addition to incorporating this refined information, the FEIS strengthened and expanded many of the discussions contained within the analysis based on public and internal comment. The resource analysis within the FEIS represents an improvement over what was presented in the DEIS. The following summarizes some of the more notable revisions by resource:

Timber

- Updated and improved unit cards;
- Unit and road configurations updated to reflect revised stream buffers, prescribed through the watershed analysis;

- Appendix A revised to reflect new information contained in the March 1996 Revised Supplement Draft TLMP EIS (TLMP RSDEIS, 1996a);
- Updates mid-market economic analysis to include revised helicopter yarding rates;
- Transition proportionality method based on volume is displayed;
- The range of silvicultural treatments was expanded;
- Improved discussion and analysis of cumulative effects of Swan Lake-Lake Tyee Powerline within the Project Area.

Wildlife

- Goat winter range habitat and effects of the alternatives were re-analyzed;
- Updates Appendix D, Biological Assessment and Biological Evaluation;
- Alternative 6 emphasizing protection of goat winter range, protection of the Southern Southeast Regional Aquaculture Association (SSRAA) fish hatchery and helicopter logging in the west fork of Carroll Creek was developed in response to public comments;
- Alternative 7 emphasizing helicopter yarding and no new road construction was developed in response to public comments;
- Improved discussion and analysis of cumulative effects of Swan Lake-Lake Tyee Powerline within the Project Area.

Soil, Water, and Air

- Watershed analysis has been dramatically expanded to include an evaluation of Anadromous Fish Habitat Assessment (AFHA) recommendations and site specific stream protection measures;
- Wetlands habitat mapping has been updated and is shown on the individual unit cards;
- The discussion of air and water quality outside the Project Area has been expanded;
- Improved discussion and analysis of cumulative effects of Swan Lake-Lake Tyee Powerline within the Project Area.

Social and Economic

- Economic analysis was updated with revised harvest volume information and updated cost information;
- Utilized IMPLAN economic model.

Marine Environment

- Improves Log Transfer Facility (LTF) discussion and analysis. Expands trade-off analysis and LTF selection rationale. Alternative 2 was modified to include the road tie from Shelter Cove to Carroll Inlet in response to public comments.

Subsistence

- Alternative 7 emphasizing helicopter yarding and no new road construction was developed in response to public comments;
- The proposed road access management plan was revised to include new road closures;
- A 300-foot no-cut buffer was placed along the main stem of Carroll Creek and its side tributaries below the falls where class I anadromous fish habitat exists (excludes the West Fork of Carroll Creek).

Recreation and Visuals

- Improved discussion and analysis of cumulative effects of Swan Lake-Lake Tyee Powerline from viewpoints within the Project Area.

Alternative Development

Each action alternative presented in this EIS is a different response to the significant issues discussed in Chapter 1. For this EIS, five action alternatives were developed to meet the stated purpose and need of the project, while minimizing or avoiding environmental impacts. Each action alternative represents a site-specific proposal developed through intensive interdisciplinary unit and road design using high resolution topographic maps, GIS mapping capabilities, and aerial photos coupled with resource inventories and site inspections.

The alternative formulation process has been guided by several concepts and principals of sound resource management. Each alternative follows the standards, guidelines, and direction contained in the Forest Plan, the Alaska Regional Guide, and applicable Forest Service manuals and handbooks. Because the timber volume may be used to satisfy part of the contractual requirements of the KPC Long-term Timber Sale Contract, they are also designed to meet the proportional harvest requirements of the Tongass Timber Reform Act (TTRA).

Ecosystem Management

Ecosystem management is a concept incorporated into forest management in recent years. The philosophy is to emphasize ecological, physical, and social sciences to guide resource management to sustain the health, productivity, and intangible values of the land. These concepts were considered in the selection and design of individual harvest units and roads included in the alternatives.

Ecosystem management looks at forest management on two levels: (1) the landscape level, which may be a geological province (geoprovince) or a large watershed; and (2) the stand level, which deals with individual harvest units. The forest plan incorporates ecosystem management at the **landscape level** through land use allocation and the development of Standards and Guidelines. This separates incompatible uses and spreads impacts out over time and space. Many issues—such as maintaining large unfragmented blocks of old growth over time and maintaining the connectivity between those blocks—can only be resolved over the entire rotation through the land use allocation or forest planning process. A site-specific project level plan evaluates the assumptions made in a higher level plan. It then implements that direction and responds to public comments through the development of alternatives which determine which stands are treated and how they are managed.

Some tools employed at the **stand level** may include:

- a deferred entry
- reducing harsh edges through unit placement, looking for opportunities to retain small patches of uncut timber in harvest units (where feasible and practical)
- maintaining existing travel corridors
- leaving snags in harvest units (where safety regulations allow)
- trying nonstandard harvest practices where resource issues and physical limitations permit.

The Upper Carroll IDT utilized a combination of public scoping issues and resource knowledge to subdivide the Upper Carroll Project Area into a variety of important landscape zones. Definition of these landscape zones considered such aspects as the amount, distribution and fragmentation of old-growth forests, the level and distribution of previous timber harvest and roading, travel and dispersal corridors between zones that can be used by animals, the existing and potential road network for accessing timber, subsistence uses, visually sensitive areas, and important recreation areas. The landscape zones also considered the recommendations of the Viable Population (VPOP) Committee on such aspects as small, medium, and large Habitat Conservation Areas (HCAs). The landscape level considerations included the characteristics of the Upper Carroll Project Area itself as well as its relationship to adjacent areas such as the Naha Roadless Area, North Revilla, Orchard Lake and Creek, Misty Fiords National Monument, Swan Lake hydroelectric facility, and Shelter Cove. Consideration was given to social factors (including subsistence use, visual concerns, SSRAA Fish Hatchery, timber harvest economics, and the transportation/utility corridors), and proposed land use designations in the development of landscape zones. Table 2-1 displays the Landscape Management Zones identified by the Interdisciplinary Team for the Upper Carroll Project Area.

Table 2-1
Upper Carroll Landscape Management Zones

Landscape Management Zones	Description
1. Large and Medium sized old-growth habitat reserve blocks	Large and medium Habitat Conservation Areas (HCAs) as defined in the 1994 Draft Interim Habitat Management Guidelines EA. No final decision has been issued. The shape and configuration displayed represents one potential way of providing core areas of unfragmented old-growth habitat reserves where significant populations of old-growth dependent species can be maintained.
1(A) Naha Block	This large old-growth habitat reserve block is comprised of the Naha LUD II Roadless Area (timber harvest is not allowed) plus a portion of Value Comparison Unit (VCU) 744 that connects to the estuary at the head of Carroll Inlet. This block is approximately 40,088 acres in size.
1(B) Traitor's Cove Block	This medium sized old-growth habitat reserve block was originally identified as old-growth retention in the North Revilla Record of Decision (ROD). It is located inside the Salt Chuck in Traitor's Cove. This block is approximately 5,498 acres in size.
1(C) Orchard Lake Block	This medium sized old-growth habitat reserve block is proposed to be managed as a Semi-remote Recreation Land Use Designation (LUD) in the TLMP RSDEIS-Preferred Alternative, which would not allow commercial timber harvest. Orchard Lake and Creek are eligible for inclusion under the National Wild and Scenic Rivers Act. The North Revilla ROD designated this block as old-growth retention for the life of the project in 1993. This block is approximately 15,087 acres in size.
1(D) Swan Lake Block	This medium sized old-growth habitat reserve block is currently designated LUD IV timber emphasis. This block is located south of the Swan Lake Hydropower facility. This block is approximately 13,474 acres in size.
2. Carroll Creek Block	The west side of Carroll Creek represents a small block of unfragmented old-growth habitat located inside the project boundary. The southwest portion of this area is adjacent to the Naha Block (see 1(A) above). This block is approximately 6,077 acres in size
3. Late-successional Travel Corridors	Travel corridors approximately one-quarter (1/4) mile wide that provide connectivity between core areas of unfragmented old-growth habitat. These corridors generally follow riparian zones or other areas of gentle topographic relief commonly utilized for migration between areas.
4. Low and Very Low Economic Zones	These zones represent areas which are only economical to harvest during market cycles with very high stumpage rates for timber or if augmentation (contributed funds) helps to offset costs. West side of Carroll Inlet - Estimated road costs to connect the Shelter Cove Road System north to the head of Carroll Inlet exceed a million dollars per mile. Virtually all of the timber within this zone has been classified as unsuitable for timber harvest due to very high mass movement potential (MMI 4 soils). There is, therefore, insufficient timber value to recover the road construction costs.

Table 2-1 (continued)
Upper Carroll Landscape Management Zones

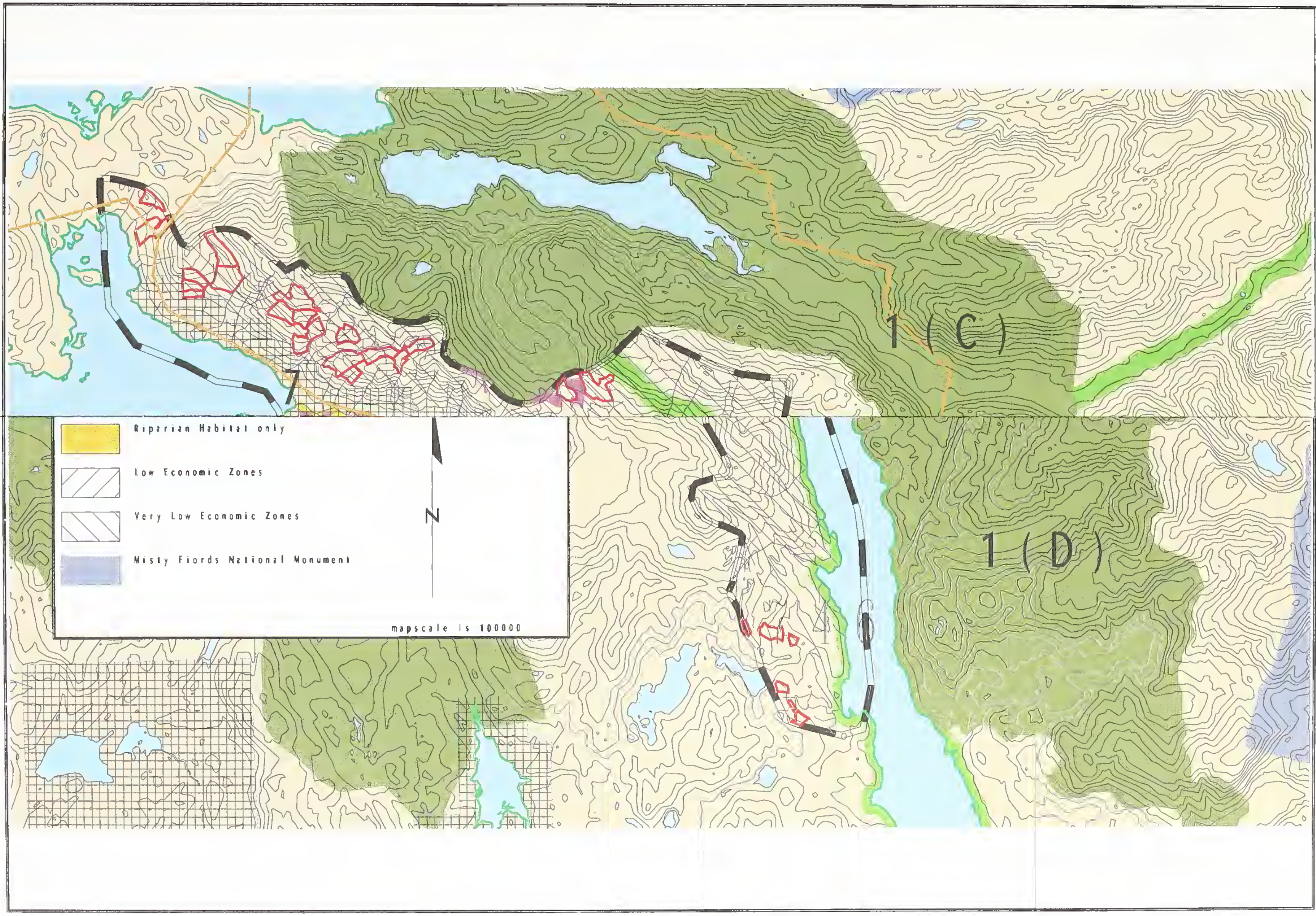
Landscape Management Zones	Description
	West side of Carroll Creek and the northern one-third (1/3) of VCU 744—there are three pockets of timber within these zones; each requires a major bridge crossing (span in excess of 100-feet) of Carroll Creek. The cost for each bridge is estimated at approximately $500,000. The possibility does exist of pulling one of the bridges in lower Carroll and re-using it in the northern portion of VCU 744 if offered as a separate offering/sale several years after lower Carroll is sold. Neets Creek VCU 737—The head of Neets Bay is within a state land selection, with the majority of the valley bottom having been extensively harvested during the 1960s. The existing road would require major reconstruction prior to being re-used. The entire southern half of the VCU and the mid-slope portion of the northern half of the VCU have been classified as unsuitable for timber harvest due to potentially unstable slopes (MMI 4 soils). The remaining upper third of the slope is located at high elevations with low volume, difficult road construction, and long helicopter yarding distances, all contributing to reduce the timber economic value of this area.
5. Riparian Habitat	Riparian areas are made up of plant communities in the vicinity of streams that are adapted to periodic inundation by water from precipitation, snowmelt, or other flood events. Riparian areas are important to the stream ecosystem because: (1) they provide shade which regulates stream temperature; (2) they provide a source of woody debris for fish habitat; (3) they help maintain the structural integrity of the streambank; and (4) litter from vegetation provides nutrients to the stream. This landscape zone contains riparian areas identified as part of the Watershed Analysis (see Chapter 3 and Appendix F).
6. Riparian Fens	Riparian fens are an important type of wetland found in footslope or valley bottom areas adjacent to lakes and streams. Hydrologically they act like a saturated sponge, slowly transferring sub-surface water from neighboring hillslopes to the stream or lake. Because fens are not stagnant, they provide a steady supply of well-oxygenated, nutrient-rich recharge to receiving water bodies. For streams, riparian fens also act as flow regulators; they capture excess runoff during storm events, store it, and then slowly release it during drier periods. This process helps maintain low flows during droughts and, to a point, buffers the stream from excessive peakflow during storms. This landscape zone contains fen areas identified as part of the Watershed Analysis (see Chapter 3 and Appendix F).
7. SSRAA Fish Hatchery	Located in VCU 737 where Neets Creek enters Neets Bay - The Southern Southeast Regional Aquaculture Association (SSRAA) operates the Neets Bay Fish Hatchery under a special use permit from the Forest Service. Fresh water from Bluff Lake is used in the hatchery operation. Water quality, particularly sedimentation, is a major concern. The Neets Bay Fish Hatchery is economically significant to the local fishing industry.

Table 2-1 (continued)
Upper Carroll Landscape Management Zones

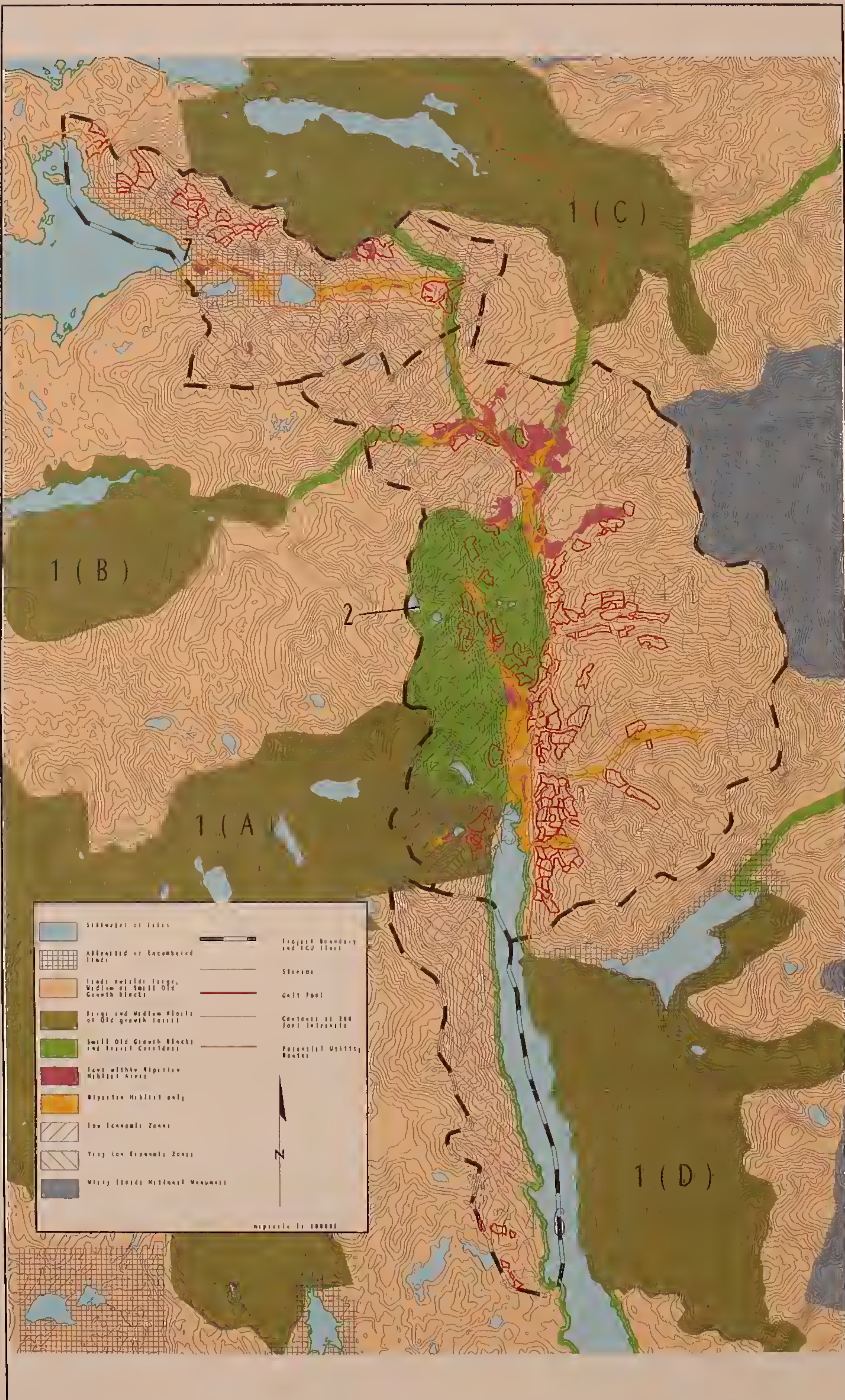
Landscape Management Zones	Description
8. Utility Corridor	The utility corridor runs north from the Swan Lake hydropower facility along the eastern shore to the head of Carroll Inlet, then follows Carroll Creek north to Neets Creek. At this point, one potential route proceeds northward around Orchard Lake outside the Project Area. A second route turns west down Neets Creek and would generally follow the existing and proposed road locations toward Shrimp Bay until leaving the Project Area. This corridor is identified here because the roads constructed for timber harvest could potentially reduce the powerline construction and maintenance costs. It is also used to help address future potential effects on scenic quality and recreation.

Chapter 3 and the Appendices contain additional maps that present some of the features described above in greater detail. The landscape management zones described in the previous table (Table 2-1) are displayed by location in Figure 2-1.

Landscape Management Zones - Upper Carroll Area



Landscape Management Zones - Upper Carroll Area



Process Used to Formulate Alternatives

A systematic, interdisciplinary approach was used in developing alternatives for making timber available. The scoping process for the Upper Carroll Project Area began in August 1994 and concluded in October of 1994. Alternative formulation began after completion of the scoping process and was designed to address public issues, Forest Service concerns, and opportunities identified in scoping.

The DEIS for this project was released in January 1996. The intent of releasing a "draft" EIS is to allow the public to comment on the alternatives so that the agency can respond to the comments and consider the public input in making a final decision on the proposed action. A total of 373 written responses to the DEIS were received. Nine more people expressed their opinions about the project during subsistence hearings in Ketchikan and Saxman, Alaska. All of this public input is considered in the final decision for this project (see Record of Decision). In response to public comments, some sections of the EIS have been expanded, and corrections have been made in other sections. Specific responses to public comments are documented in Appendix L. All alternatives have been modified to varying degrees to address public comments and concerns. The following general guidelines were used to formulate alternatives:

Address the Issues Identified During the Scoping and Public Comment Periods

This ensures that the interests of the various citizens, groups, and organizations that could be affected by this project are reflected in the alternatives.

Integrated Resource Analysis Focused on the Proposed Action

Forest Plan implementation begins with a comparison of the existing condition with the management emphasis for the area, and is followed by a determination of what, if any, changes are necessary. The purposes of integrated resource analysis are to determine possible combinations of management practices that are responsive to identified changes and to ensure that these combinations are consistent with Forest Plan direction.

Adherence to Forest Plan objectives and standards is an essential component of Forest Plan implementation [36 CFR 219.10(e);36 CFR 219.11(c)]. The key Forest Plan standards establish limits on adverse environmental impacts and require that unless specified levels of mitigation can be achieved, a project or activity won't be implemented. Thus the list of possible management practices which would work toward the desired future condition for timber must be consistent with the need to meet Forest Plan standards and objectives for other resources.

Evaluate a Reasonable Range of Alternatives

The issues, the ways of addressing the issues, and possible levels of resource use on Revilla Island vary widely. The ID Team concentrated on providing a range of alternatives by varying the location and mixes of resources committed under each alternative and by varying the number and kinds of activities to be conducted.

Section 102(2)(e) of NEPA states that all Federal agencies shall "... study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources." These unresolved conflicts, identified by the Forest Service and the public, are the NEPA issues related to the proposed action.

In addition to responding to unresolved conflicts, an EIS must "...rigorously explore and objectively evaluate all reasonable alternatives" [40 CFR 1502.14(a)]. The courts have established that this direction does not mean that every conceivable alternative must be considered, but that selection and discussion of alternatives must permit a reasoned choice and foster informed decision making and informed public participation.

Taken together, these requirements determine the NEPA range of alternatives.

Upper limits on timber outputs and associated road mileages considered in this EIS are imposed by Tongass Land Management Plan (TLMP 1979a, as amended) Standards and Guidelines for other resources as well as legal obligations for timber harvest set out in 36 CFR 219.27 and Section 6(g)(3)(e) of the National Forest Management Act.

Lower limits on timber outputs and associated road mileages are directly related to the issues and concerns, as well as the purpose and need for action described in Chapter 1.

Consistency with TLMP RSDEIS, Preferred Alternative (USDA Forest Service 1996a) Standards and Guidelines

This FEIS was developed consistent with the Standards and Guidelines in the Preferred Alternative of the TLMP RSDEIS (1996a) to the maximum extent practicable. The documented analysis and relevant discussion from this set of documents has been incorporated by reference rather than repeated (40 CFR 1502.21).

Follow an Interdisciplinary Process

This systematic, interdisciplinary approach ensures the integrated use of the natural and social sciences and the environmental design arts in planning and in decision making which may have an impact on the environment.

Alternatives Eliminated from Detailed Study

A number of alternatives were examined, but not considered for detailed study in this FEIS. This section presents those alternatives and the rationale for excluding them from further consideration.

Alternative A

Single Resource or Issue

Alternatives that focused solely upon one resource or issue were eliminated from consideration as implementable alternatives. While alternatives constructed around a single resource may not be implementable, the issue itself may still be significant. Each alternative will be evaluated against all the significant issues.

Alternative B

Transportation/Utility Corridor between Ketchikan and the Project Area

The proposed road link and utility corridor are separate projects and independent from this FEIS. The road link project is not reasonably foreseeable. Ketchikan Public Utilities has awarded a contract to Foster Wheeler Environmental Corporation to complete an EIS for the proposed electrical intertie (including associated roads, if any) from Swan Lake to Lake Tyee. The preliminary preferred powerline route includes approximately 30 to 40 miles within the Upper Carroll Project Area. The two proposed actions appear to be similar because of the potential road locations and opportunity for cooperative agreements. The similar time lines could make the issue ripe for a decision as well. Alternative 2, looks at how much timber and associated roads could be built and still meet Forest Plan Standards and Guidelines. The question as to how much of the transportation/utility corridor could be built is addressed for

each alternative, with Alternative 2 serving as the upper level benchmark. A separate alternative, which maximizes road construction for the transportation/utility corridor is, therefore, unnecessary.

Alternative C

Avoid Previously Mapped Old-growth Retention Areas

Several commenters asked the Forest Service to analyze an alternative that would keep intact all previously mapped old-growth retention during this entry. Under the TLMP RSDEIS (1996a), 16 out of 19 land use designations preclude or severely restrict timber harvest, including the establishment of old-growth habitat reserves. The Standards and Guidelines for the remaining LUDs retain unaltered old-growth habitat in beach, estuary, and TTRA buffers, as well as in unsuitable commercial forest land. Previously mapped old-growth retention areas are consequently considered as part of the tentatively suitable and available timber base, unless otherwise excluded. Approximately 5,147 acres of retention were established as part of previous project level EISs.

The IDT examined the possibility of constructing an alternative which avoided all previously mapped old-growth retention areas. Due to the location and disjointed smaller patch size, it was impossible to construct an economically viable alternative which completely avoided existing retention with all roads and units. Many of the retention blocks were located at higher elevations, in low volume stands, were small and narrow, and did not logically connect to other high value areas. Current conservation biology theory places greater emphasis on larger blocks of old-growth which have logical connections for wildlife movement. This alternative was, therefore, not considered in detail. The effects of the alternatives on previously mapped old-growth areas are considered in Chapter 3.

Alternative D

Neets Bay/Orchard Lake Alternative

Several commenters asked the Forest Service to eliminate specific areas or individual units that were of concern to them. For example, the Southern Southeast Regional Aquaculture Association (SSRAA) operates the Neets Bay Fish Hatchery under special use permit from the Forest Service. A number of comments received indicated that the proposed harvest in Neets Bay would pose a sedimentation risk to the fish hatchery operation. A citizen's alternative recommended dropping the Neets Bay harvest units and making up the volume from the Orchard Lake area.

Harvesting in the Orchard Lake area was not considered because: (1) it is a recommended semi-remote recreation area under the TLMP RSDEIS (1996a), Preferred Alternative; (2) Orchard Lake and Creek have been determined to be eligible for possible inclusion in the National Wild and Scenic Rivers System; and (3) it is outside the Project Area boundary.

Concern about sedimentation from timber harvest and associated roads was addressed in various ways. Alternatives 3, 6 and 7 do not propose any harvest in the Neets Creek watershed, while Alternatives 2 and 5 propose distinctly different levels of harvest and road construction within the watershed. A watershed analysis which looks at sedimentation risk was conducted for both the Neets Creek and Carroll Creek drainages (see Chapter 3). Forest Service Standards and Guidelines, as well as BMPs to protect soil and water quality, apply to all alternatives.

Alternative E

Helicopter Logging Alternative

Public comments expressed a concern for the effects of road and LTF construction on the marine environment as well as the Carroll Creek estuary, water quality, fisheries, and subsistence values. Alternative E in the Upper Carroll DEIS was originally developed as a project alternative by the IDT but eliminated from detailed study due to poor economic returns and not meeting the project's stated purpose and need.

In conversations with members of the Ketchikan Indian Corporation's subsistence board the Forest Service received clarification regarding new roads versus existing roads. The primary concern was to avoid the construction of new roads to limit additional subsistence impacts. The ability to re-construct the existing roads is critical to the viability of this alternative, since it reduces the yarding/flight distances by several miles. This is due to the fact that the shallow water in Carroll Estuary prohibits the placement of a barge closer than the proposed LTF location used in the other alternatives. The reconstruction of the existing roads results in additional volume and improved economics.

Alternative E from the DEIS has been modified as described above and is considered for detailed study in the FEIS as Alternative 7.

Alternative F

"Fishermen's Alternative"

The proposed "Fishermen's Alternative" was evaluated by the Upper Carroll IDT. Constraints applied by the commenter were that no harvesting occur north of , and including Unit No. 49 (DEIS) (first drainage to the east of Carroll Creek). The alternative would need to meet proportionality, which would be very difficult because all of the remaining units in VCU 744 but one are composed of high volume stands. The constructed alternative would have resulted in approximately six MMBF of harvest in Management Area K32 (VCU 744) and approximately one to two MMBF in Management Area K35 (VCU 746).

This alternative was considered but eliminated from detailed study because:

- it does not address any significant issues in a way that is meaningfully different;
- the economic viability is hampered by the low volume to spread fixed costs against;
- the alternative does not respond to the underlying purpose and need for the project (40 CFR 1502.13).

Alternative G

In public comments received on the DEIS, Alternatives 3 and 4 received a considerable amount of support from individuals and agencies who emphasize the protection of water quality, fisheries and wildlife habitat. Fewer acres of timber harvest, less road construction, avoiding impacts to the SSRAA facility and the west side of Carroll Creek were commonly mentioned reasons. Most of the commenter's indicated that they saw little difference between Alternatives 3 and 4, but preferred Alternative 3 because it constructed less road, harvested fewer acres of old-growth timber, and was economically more efficient.

In the DEIS, Alternative 4 harvested the northern portion of VCU 744 while Alternative 3 did not. Additional analysis after the DEIS resulted in Units 75 and 129 being deleted for low volume (less than 8 MBF/acre). As a result, Units 15 and 108 located adjacent to the units listed above could no longer support the roading costs associated with providing access. The end result being that Alternative 3 and 4 would have had no meaningful difference if both were carried forward to the FEIS.

DEIS Alternative 3 plus Units 73, 74, 130, 131 and 132 (DEIS) (approximately 3.5 MMBF) from Alternative 4 will be presented in the FEIS as Alternative 3. Alternative 4 has been eliminated from further detailed study.

Alternatives Considered for Detailed Study

Six alternatives for making timber available to local timber purchasers from the Upper Carroll Project Area were considered in detail. Each alternative is consistent with the TLMP (1979a, as amended) and the Preferred Alternative of the TLMP RSDEIS (1996a). For each alternative this section provides a discussion of: (1) the emphasis or intent of the alternative; (2) various resource outputs associated with implementation; and (3) environmental consequences. Alternatives are compared in detail later in this chapter and summarized in Table 2-2.

Alternative 1 (No Action)

Emphasis

The emphasis of this alternative is to propose no new timber harvest from the Upper Carroll Project Area at this time. It does not preclude timber harvest from other areas at this time, or from the Upper Carroll Project Area at some time in the future. The Council on Environmental Quality (CEQ) regulations 40 CFR 1502.14d requires a "No Action" alternative be analyzed in every EIS. This alternative serves as a benchmark by which effects of the other action alternatives are to be measured. The Existing Condition map shows the distribution of vegetation associated with no new timber harvest.

Outputs

There are no new timber harvest outputs associated with this alternative. Visual quality, wildlife habitat quality, semi-primitive recreation opportunities, as well as other resource values would remain at their current condition.

Alternative 2

Emphasis

The emphasis of this alternative is to accelerate progress toward the desired future condition for timber management while meeting Forest Plan Standards and Guidelines for other resources. Timber volume made available to local timber purchasers is maximized this entry under this alternative. This alternative is designed to evaluate the effects of harvesting as much of the Project Area as possible in a combination that still meets standards and guidelines. This alternative serves as an upper level benchmark that can be used to project the cumulative affects of the reasonably foreseeable future activities (see Appendix A) within the Project Area. Another feature of this alternative is that it looks at the maximum amount of road that could be constructed as part of a commercial timber sale that could be used to facilitate the development of a potential transportation/utility intertie within the Project Area. The environmental effects and cost of a road connection between Shelter Cove and Carroll Inlet have been incorporated into this alternative .

Outputs

Implementation of this alternative would schedule the harvest of 1,996 acres, in 72 harvest units for approximately 61 MMBF of sawlog and utility volume, indicating an average unit size of 27.7 acres. Of this harvest, 13 units totaling 332 acres are planned for partial cut; the remainder are planned for clearcut harvest. To implement this level of harvest, 61 miles of new road would be constructed, and 7 miles of existing road would require reconstruction. Road construction clearing will yield an additional 3 MMBF of right-of-way (ROW) volume. This indicates an average of 1.1 MMBF per mile of new road construction and a total of 0.9 MMBF per mile of road. It schedules 368 acres or 11.2 MMBF of volume for helicopter yarding. Preliminary analysis indicates a net mid-market stumpage value of $-158.40 per MBF. This alternative would result in approximately 31.9 miles of road located within a proposed transportation corridor or 23.2 miles within a utility corridor that could facilitate its future construction and/or maintenance.

The use of two existing LTFs will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove and Shrimp Bay LTFs. The road connection between Shelter Cove and Carroll Inlet would eliminate the need for the Carroll Inlet LTF and floating log camp. The Alternative 2 map provides the spatial relationship among roads, units and other geographic features of the Upper Carroll Project Area.

Alternative 3 Preferred Alternative

Emphasis

The objective of this alternative is to emphasize timber economics and conventional cable yarding methods. The location of harvest units, selection of silvicultural prescriptions, logging systems, and a transportation network is primarily based on maximizing the mid-market value. This entry proposes only limited helicopter timber harvest. This approach emphasizes a positive net economic return for the proposed harvest units, by avoiding the low and very low economic zones. Due to the juxtaposition of the landscape management zones within the Project Area, this alternative minimizes impacts to old-growth habitat blocks, late-successional corridors, riparian habitat, fens, the SSRAA Fish Hatchery in Neets Bay, and avoids the west side of Carroll Creek. Development of the transportation/utility corridors would be minimized as a consequence of harvesting a lesser amount of timber and constructing fewer miles of road.

Outputs

Alternative 3 schedules the harvest of 40 individual harvest units, totaling 33 MMBF of sawlog and utility volume from 1,074 acres, indicating an average unit size of 26.9 acres. Of this harvest, 3 units totaling 15 acres are planned for partial cut; the remainder are planned for clearcut harvest. This alternative requires the construction of 21 miles of new specified roads plus 4 miles of reconstruction. Road construction clearing will yield an additional 1 MMBF of right-of-way (ROW) volume. This indicates an average of 1.6 MMBF per mile of new road construction and a total of 1.4 MMBF per mile of specified road. It schedules 51 acres or 1.3 MMBF of volume for helicopter yarding. Preliminary analysis indicates a net mid-market stumpage value of $+19.06 per MBF. This alternative would result in approximately 4.2 miles of road located within a proposed transportation corridor or 6.5 miles within a utility corridor that could potentially facilitate its future construction and/or maintenance.

The development of one new Log Transfer Facility (LTF) and one existing LTF will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove and Carroll Inlet LTFs. The Alternative 3 map provides the spatial relationship among roads, units, and other geographic features of the Upper Carroll Project Area.

Alternative 5

Emphasis

The emphasis of this alternative is to meet the stated purpose and need while responding to public comments to avoid road construction in Neets Bay (VCU 737) by helicopter logging the units to the north of the SSRAA facility and dropping the remaining roaded access units located further up-stream from the SSRAA fish hatchery. This alternative differs from Alternative 2 in that less volume is harvested, no road construction occurs in the Neets Bay Drainage (VCU 737), no harvest occurs in the Naha large old-growth block, and the road tie from Shelter Cove to Carroll Inlet would not be constructed.

Outputs
Alternative 5 schedules the harvest of 60 individual harvest units, totaling 51 MMBF of sawlog plus utility volume from 1,618 acres, indicating an average unit size of 27.0 acres. Of this harvest, 15 units totaling 252 acres are planned for partial cut; the remainder are planned for clearcut harvest. This alternative requires the construction of 40 miles of new specified roads plus 8 miles of reconstruction. Road construction clearing will yield an additional 2 MMBF of right-of-way (ROW) volume. This indicates an average of 1.3 MMBF per mile of new road construction and a total of 1.1 MMBF per mile of specified road. It schedules 393 acres or 13 MMBF of volume for helicopter yarding. Preliminary analysis indicates a net mid-market stumpage value of $-53.64 per MBF. This alternative would result in approximately 6.8 miles of road located within a proposed transportation corridor or 8.9 miles with a utility corridor that could potentially facilitate its future construction and/or maintenance.

The development of one new Log Transfer Facility (LTF) and two existing LTFs will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove, Shrimp Bay and Carroll Inlet LTFs. The Alternative 5 map provides the spatial relationship among roads, units, and other geographic features of the Upper Carroll Project Area.

Alternative 6

Emphasis
The emphasis of this alternative is to meet the stated purpose while responding to public comments to minimize or avoid impacts to goat winter range, the SSRAA Fish Hatchery, and the west side of Carroll Creek. This alternative would avoid road construction in the old-growth block located on the west side of Carroll Creek through the use of helicopter yarding. Neets Creek drainage (including the SSRAA Fish Hatchery) and potential goat winter range would be completely avoided.

Outputs
Alternative 6 schedules the harvest of 42 individual harvest units, totaling 32 MMBF of sawlog plus utility volume from 1,032 acres, indicating an average unit size of 24.6 acres. Of this harvest, 5 units and 100 acres are planned for partial cut; the remainder are planned for clearcut harvest. This alternative requires the construction of 19 miles of new specified roads plus 4 miles of reconstruction. Road construction clearing will yield an additional 1 MMBF of right-of-way (ROW) volume. This indicates an average of 1.7 MMBF per mile of new road construction and a total of 1.4 MMBF per mile of road. It schedules 288 acres or 9.0 MMBF of volume for helicopter yarding. Preliminary analysis indicates a net mid-market stumpage value of $-8.64 per MBF. This alternative would result in approximately 6.8 miles of road located within a proposed transportation corridor or 8.9 miles within a utility corridor that could potentially facilitate its future construction and/or maintenance.

The development of one new Log Transfer Facility (LTF) and one existing LTF will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove and Carroll Inlet LTFs. The Alternative 6 map provides the spatial relationship among roads, units, and other geographic features of the Upper Carroll Project Area.

Alternative 7

Emphasis

The emphasis of this alternative is to meet the stated purpose while responding to public comments to avoid new road construction and utilize helicopter yarding. Under this alternative the existing road in Carroll Creek would be reconstructed to minimize helicopter yarding costs. Avoiding new road construction addresses the subsistence, fisheries and wildlife issue of roaded access differently than standard road closures. The Naha and West Carroll old-growth blocks receive a light entry under this alternative. Development of the transportation/utility corridors would be minimized as a consequence of only reconstructing the existing roads.

Outputs

Alternative 7 schedules the harvest of 24 individual harvest units, totaling 19 MMBF of sawlog plus utility volume from 591 acres, indicating an average unit size of 24.6 acres. Of this harvest, 3 units and 37 acres are planned for partial cut; the remainder are primarily planned for Type II clearcut harvest. This alternative requires the reconstruction of 4 miles of specified roads. Road reconstruction clearing will yield no right-of-way (ROW) volume. It schedules 540 acres or 17.1 MMBF of volume for helicopter yarding with the Shelter Cove area (VCU 746) continuing to be cable logged from the existing road system. Preliminary analysis indicates a net mid-market stumpage value of $-17.43 per MBF. This alternative would result in approximately 0.4 miles of road located within a proposed transportation corridor or 2.7 miles within a utility corridor that could potentially facilitate its future construction and/or maintenance.

The development of one new Log Transfer Facility (LTF) and one existing LTF will be required to implement this alternative. Floating or land based logging camps are anticipated with the Shelter Cove and Carroll Inlet LTFs. The Alternative 7 map provides the spatial relationship among roads, units, and other geographic features of the Upper Carroll Project Area.

Forest Service Preferred Alternative

Using an evaluative process that compares the benefits and adverse effects of each alternative against the issues, the USDA Forest Service has identified Alternative 3 as the preferred alternative for this EIS. A final determination will be made by the Ketchikan Area Forest Supervisor in the Record of Decision (ROD)

Comparison of Alternatives

The comparison of alternatives draws together the conclusions from the analysis presented throughout the document and provides a summary of the results. Table 2-2 provides a summary of activities, outputs, and environmental consequences by which the alternatives may be compared. The following sections provide a comparison of alternatives by: (1) summary comparison of outputs and environmental consequences; (2) proposed activity; and (3) significant issues.

Summary Comparison

Table 2-2 provides a summary of activities, outputs, and environmental consequences by which the alternatives may be compared.

Table 2-2
Summary Comparison of Alternatives

Activity/Resource	Units	Alternatives 1	2	3	5	6	7
Timber							
Units	Number	0	72	40	60	42	24
Estimated harvest unit volume	MMBF	0	61	33	51	32	19
Estimated right-of-way (ROW) volume	MMBF	0	3	1	2	1	0
Partial cut (shelterwood)	Acres	0	332	15	252	100	37
Clearcut harvest (Type I and II)	Acres	0	1,664	1,059	1,366	932	554
Total harvest	Acres	0	1,996	1,074	1,618	1,032	591
Units over 100 acres	Number	0	1	1	2	0	0
Shovel harvest	MMBF	0	1.3	0.9	1.0	0.8	0.2
Running Skyline	MMBF	0	44.2	29.3	33.9	21.6	1.2
Live Skyline (Shotgun)	MMBF	0	3.1	1.2	2.6	0.9	0
Slackline harvest	MMBF	0	1.4	0	0.7	0	0
Helicopter harvest	MMBF	0	11.2	1.3	12.7	9.0	17.1
Estimated stumpage (mid-market rates)	$ / MBF	0	-158.40	+19.06	-53.64	-8.64	-17.43
Estimated stumpage (current rates)	$ / MBF	0	-137.42	+51.05	-33.50	+9.26	- 0.43
Receipts to State of Alaska	$M	0	3,318	2,208	2,915	1,758	118
Average annual jobs over 4 years	No. of jobs	0	119	65	99	63	36
Proportionality Remaining (K32 - TTRA Base 8.82%)	Percent	8.95	8.87	8.84	8.82	8.88	8.88
Proportionality Remaining (K35 - TTRA Base 5.39%)	Percent	5.54	5.55	5.55	5.54	5.54	5.55
Roads and Transportation							
Specified road construction	Miles	0	61.2	21.1	39.8	19.3	0.0
Road reconstruction	Miles	0	6.6	3.7	7.9	3.7	3.7
Temporary road construction	Miles	0	10.9	7.4	10.2	5.2	0.5
New Log Transfer Facilities	Each	0	0	1	1	1	1
Reconstruction/Use of existing Log Transfer Facilities	Each	0	2	1	2	1	1
Roads crossing Class I or II streams	Number	0	40	22	34	23	9
Transportation/Utility Corridor							
Transportation Corridor (32-45 miles)	Miles	0	31.9	4.2	6.8	6.8	0.4
Utility Corridor (25 miles)	Miles	0	23.2	6.5	8.9	8.9	2.7
Road Connection from Shelter Cove to Carroll Creek	Response	No	Yes	No	No	No	No
Road Connection from Carroll Creek to Neets Creek Road	Response	No	Yes	No	No	No	No
Road Connection from Carroll Creek to Shrimp Bay	Response	No	Yes	No	No	No	No
Biodiversity							
Unfragmented old-growth patches remaining							
1,000 Acres and larger	Acres	11,735	4,563	7,135	4,494	7,940	7,724
500-1,000 Acres	Acres	2,270	5,881	4,381	6,282	4,058	4,601
100-500 Acres	Acres	2,243	3,492	3,329	3,607	2,920	3,027
Naha old growth habitat - large block	Acres harvested	0	48	0	0	0	48
Carroll Creek old growth habitat - small block	Acres harvested	0	302	0	317	237	43
Corridors connecting old growth blocks (2,737 acres)	Acres harvested	0	73	25	60	60	1
Old growth acres remaining in Project Area	Acres	17,641	15,644	16,567	16,023	16,609	17,050
Percent of original old-growth remaining	Percent	81	72	76	74	77	79
Wildlife - Project Area							
1997 MIS - deer	Habitat capability	389	357	371	364	367	376
1997 MIS - bear	Habitat capability	70	66	67	67	67	68
1997 MIS - marten	Habitat capability	45	40	42	41	42	43
1997 MIS - river otter	Habitat capability	17	16	16	16	16	16
1997 MIS - hairy woodpecker	Habitat capability	341	303	320	311	318	325
1997 MIS - Vancouver Canada goose	Habitat capability	74	67	68	67	68	69
1997 MIS - bald eagle	Habitat capability	40	40	40	40	40	40
1997 MIS - brown creeper	Habitat capability	497	444	468	455	468	477
1997 MIS - red squirrel	Habitat capability	22,714	21,226	21,890	21,554	21,858	22,178
1997 MIS - gray wolf	Habitat capability	1.1	1.0	1.1	1.0	1.1	1.1
1997 MIS - goat winter range (2044 acres)	Acres harvested	0	229	274	229	71	30

Table 2-2 (continued)
Summary Comparison of Alternatives

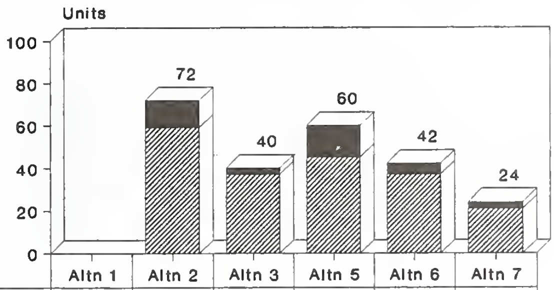
Activity/Resource	Units	Alternatives 1	2	3	5	6	7
Subsistence - WAAs 406 and 510							
Deer Habitat Capability (percent of 1954)	Percent	81	81	81	81	81	81
Deer Population Needed to Support Current Harvest (percent of 1954)	Percent	19	19	19	19	19	19
Significant Possibility of a Significant Restriction							
Deer	Response	No	No	No	No	No	No
Bear	Response	No	No	No	No	No	No
Furbearers	Response	May	May	May	May	May	May
Salmon	Response	No	No	No	No	No	No
Other Finfish	Response	No	No	No	No	No	No
Waterfowl	Response	No	No	No	No	No	No
Marine Mammals	Response	No	No	No	No	No	No
Indirect and Cumulative Effects of Implementing the Forest Plan over the entire rotation	Response	May	May	May	May	May	May
Cultural Resources							
Impacts to known cultural resources	Response	No	No	No	No	No	No
Watershed and Fisheries							
Fens (watershed assessment) 1,192 acres	Acres harvested	0	0	0	0	0	0
Riparian habitat (watershed assessment) 1,912 acres	Acres harvested	0	0	0	0	0	0
Neets Creek Watershed (contains SSRAA Fish Hatchery)							
Acres of harvest	Acres	0	366	0	201	0	0
Miles of road construction and reconstruction	Miles	0	17	0	0	0	0
Harvest unit acres with high potential for sediment delivery to Neets Creek	Acres	0	26	0	26	0	0
Road miles with high potential for sediment delivery to Neets Creek	Miles	0	1.2	0	0	0	0
Carroll Creek Watershed							
Acres of harvest	Acres	0	1,581	1,025	1,397	1,020	541
Miles of road construction and reconstruction	Miles	0	45	25	33	23	4
Harvest unit acres with high potential for sediment delivery to Class I streams	Acres	0	192	142	192	86	0
Road miles with high potential for sediment delivery to Class I streams	Miles	0	6.2	2.3	5.5	0.8	0.0
Soils							
Very high mass movement	Acres harvested	0	0	0	0	0	0
High mass movement	Acres harvested	0	520	245	455	231	107
Medium mass movement	Acres harvested	0	1,156	679	973	655	350
Low mass movement	Acres harvested	0	320	150	190	146	135
Wetlands harvested/roaded	Acres	0	386	70	275	231	66
Total Karstlands in each Alternative	Acres	0	0	0	0	0	0
Visual Quality							
Consistent with Forest Plan Objectives							
Carroll Inlet at Shelter Cove - VCU 746	Response	Yes	Yes	Yes	Yes	Yes	Yes
Carroll Estuary - VCU 744	Response	Yes	Yes	Yes	Yes	Yes	Yes
Head of Neets Bay - VCU 737	Response	Yes	Yes	Yes	Yes	Yes	Yes
Roadless Areas							
Change in ROS class from SPNM to RM	Percent	0	22	13	17	10	4
Roadless areas	Acres (M)	34,413	24,925	30,217	27,440	29,954	34,413

SOURCE: Nightingale 1996

Comparison of Alternatives by Proposed Activity

The action alternatives propose the harvest of from 24 to 72 individual units. Alternative 5 proposes the most units for partial cutting (15), while Alternative 3 and 7 propose only three units for partial cutting. Figure 2-2 shows the number of units proposed for harvest under each alternative by silvicultural system.

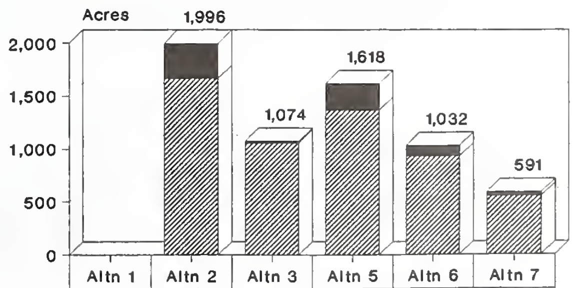
Figure 2-2
Number of Units Proposed for Harvest by Silvicultural System



	Altn 1	Altn 2	Altn 3	Altn 5	Altn 6	Altn 7
Shelterwood	0	13	3	15	5	3
Clearcut	0	59	37	45	37	21

Alternative 2 proposes the highest level of harvest with approximately 1,996 acres of timber harvest. Of the action alternatives, Alternative 7 proposes the lowest level of harvest with 591 acres. Figure 2-3 shows the number of acres proposed for harvest by each alternative by silvicultural system.

Figure 2-3
Total Acres Proposed for Harvest by Silvicultural System

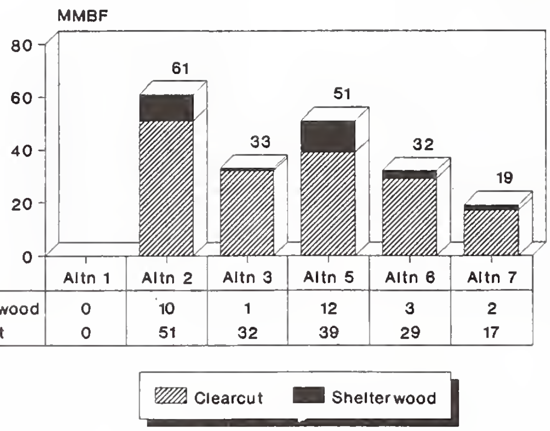


	Altn 1	Altn 2	Altn 3	Altn 5	Altn 6	Altn 7
Shelterwood	0	332	15	252	100	37
Clearcut	0	1,664	1,059	1,366	932	554

2 Alternatives

Excluding right-of-way (ROW) volume each action alternative generated less volume than the identified purpose and need. Alternative 7 provides the least volume at 19 MMBF and Alternative 2 comes closest to 70 MMBF, with 61 MMBF. Figure 2-4 shows the volume of timber proposed for harvest by each alternative by silvicultural system.

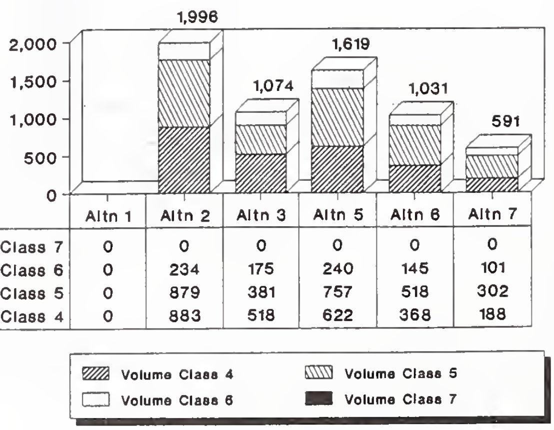
Figure 2-4
Total Volume Proposed for Harvest



	Altn 1	Altn 2	Altn 3	Altn 5	Altn 6	Altn 7
Shelterwood	0	10	1	12	3	2
Clearcut	0	51	32	39	29	17

Commercial forest land (CFL) is divided into Volume Class Strata according to the Ketchikan Area's timber type map. This volume class information is used in calculating volume harvested and economic analysis. Figure 2-5 shows volume class strata breakdown for each alternative. Inclusions of stands typed as non-commercial forest that were field verified to be merchantable were aggregated into the volume class 4 acres.

Figure 2-5
Proposed Harvest by Volume Class Strata



	Altn 1	Altn 2	Altn 3	Altn 5	Altn 6	Altn 7
Volume Class 7	0	0	0	0	0	0
Volume Class 6	0	234	175	240	145	101
Volume Class 5	0	879	381	757	518	302
Volume Class 4	0	883	518	622	368	188

The Tongass Timber Reform Act (TTRA 1990) modified the Long-term Timber Sale Contracts in Alaska to "...*eliminate the practice of harvesting a disproportionate amount of old-growth timber by limiting the volume harvested over the rotation in volume class 6 and 7.*" The Forest Service developed the Forest Service Handbook procedures and implementation instructions for conducting proportionality analysis in January 1992, and updated the procedures in August 1993. The calculation of proportionality is based on dividing the Timber Type Map (TIMTYP) high volume class acres by the total volume class acres within a Management Area. The proportionality in a Management Area after timber harvest is compared with the proportionality calculated for December 1990 conditions to verify that TTRA is satisfied.

The Kelp Bay Timber Sale (Record of Decision February 1992) was the first timber offering completed using the proportionality analysis as directed by Forest Service Handbook (FSH) guidelines. A lawsuit was brought against the Forest Service challenging this method. In April 1994, the federal district court ruled in favor of the plaintiffs (Wildlife Society, et al. v. Barton, J93-001 CV, D. Alaska) and directed the Forest Service to develop a more accurate method of calculating proportionality for the purpose of TTRA based on timber volume, or to better explain its reasons for rejecting the methods proposed by plaintiffs.

In response, the Forest Service developed a transition method of calculating volume-based proportionality using existing timber inventory information (*Alternatives to Using the Timber Type Map for Determining Proportionality Under the Tongass Timber Reform Act*, Wilson and Golnick, 1995). Upon review by the plaintiffs, they requested that the transition method not be implemented pending findings of a pilot study being conducted by Enserch Environmental Corporation in Management Area K15 of the Control Lake Project Area (*Evaluation of Photo-Point Inventory Methods for the Estimation of Timber Volume and Proportionality in Southeast Alaska*, Foster Wheeler Environmental Corporation with Harza Northwest, 1995). This study was based on previous methods identified by Wilson et al. which look at the feasibility of using double sampling methods in association with existing stand exam data. Based on the need for additional information and evaluation of this study, the Forest Service extended the original contract with Foster-Wheeler Environmental Corporation to test the accuracy of the low-altitude photo measurement procedure. Their report, *Estimation of Timber Volume in Southeast Alaska Using Low-Altitude Fixed Base Aerial Photography* (Foster Wheeler Environmental Corporation with Richard A. Grotefendt. 1996) is currently being assessed by the Forest Service. Further negotiations with litigants have been proceeding. Until a final agreement is reached, and updated FSH guidelines are established, the Upper Carroll FEIS proportionality analysis will follow the procedures established in the current FSH as well as the transition method that was developed by Wilson in 1994.

Acre or Timber Type Map Method

The Project Area is primarily located within Management Area K32 and contained 8.82 percent proportion of Volume Class 6 and 7 timber as of November 1990 (Date TTRA became law). The current proportionality is 8.95 percent. All alternatives would result in a proportionality equal to or in excess of 8.82 percent.

A small portion of Management Area K35 (VCU 746) is located within the Project Area. The TTRA baseline proportion is 5.39 percent and the current proportionality is 5.54 percent. All of the action alternatives will maintain or slightly increase proportionality over the existing condition.

Table 2-3 displays the proportion of Volume Class 6 and 7 acres proposed for harvest by Management Area using the Forest Service Handbook (FSH 2409.18-93-3) method. Under this method alternatives are considered within the required proportion if the difference or

change from base value is positive. If the difference or change from base is negative, the alternative is considered out of proportion.

Table 2-3
Proportion of Volume Classes 6 and 7 Proposed for Harvest by Management Area as Described by Proportionality Analysis Method FSH 2409.18-93-3

	Total Timber Base (acres)	Volume Class 6 & 7 (acres)	Proportionality (percent)	Difference (percent)1/
Management Area K32				
TTRA Baseline (on November 28, 1990)	83,049	7,328	8.82	
Post TTRA Harvest	76,084	6,812	8.95	+0.13
Alternative 1	76,084	6,812	8.95	+0.13
Alternative 2	74,138	6,578	8.87	+0.05
Alternative 3	75,060	6,637	8.84	+0.02
Alternative 5	74,486	6,572	8.82	+0.00
Alternative 6	75,064	6,666	8.88	+0.06
Alternative 7	75,543	6,711	8.88	+0.06
Management Area K35				
TTRA Baseline (on November 28, 1990)	47,314	2,552	5.39	
Post TTRA Harvest	46,058	2,552	5.54	+0.15
Alternative 1	46,058	2,552	5.54	+0.15
Alternative 2	46,008	2,552	5.55	+0.16
Alternative 3	46,008	2,552	5.55	+0.16
Alternative 5	46,038	2,552	5.54	+0.15
Alternative 6	46,046	2,552	5.54	+0.15
Alternative 7	46,008	2,454	5.55	+0.16

SOURCE: Nightingale and Marks, 1996

1/ A positive difference indicates that the percent of Volume Classes 6 and 7 remaining in the Management Area is higher than the TTRA baseline. A negative difference indicates a lower percentage than the TTRA baseline.

Transition Proportionality Analysis Method

The Transition Proportionality Analysis Method developed by Wilson and Golnick in 1994 is also used to determine the proportionality within Management Areas K32 and K35. This method was developed in response to the Wildlife Society lawsuit. The Transition Method uses the methodology of adjusting the total acres of each volume class to correct for inaccuracies in the TIMTYP mapping of volume classes present at the local level. This adjustment is based on previously collected field data for each Administrative Area. The acres in each volume class are then multiplied by the average volume per acre for each volume class (also based on Administrative Area field data) to calculate the total volume present in each volume class. The volume of Volume Classes 6 and 7 is then divide by the total volume present in Volume Classes 4 through 7 to determine the proportion of high volume with the management area.

This approach differs from the acreage-based approach in two ways. First, this approach uses volume instead of acres to determine the proportion. Second, the process includes an adjustment to account for incorrectly mapped stands in all volume classes. Because this approach is based on volume, and volume per acre varies between volume classes, harvest of Volume Class 7 acres will have a greater effect on proportionality than harvest of Volume Class 6 acres. Similarly, harvest of Volume Class 5 will be more effective in meeting the proportionality requirement, acre per acre, than the harvest of Volume Class 4.

Table 2-4 displays the proportionality for each alternative using the transition method developed by Wilson and Golnick.

Table 2-4
Proportion of Volume Classes 6 and 7 Proposed for Harvest by Management Area as Described by the Transition Proportionality Analysis Method

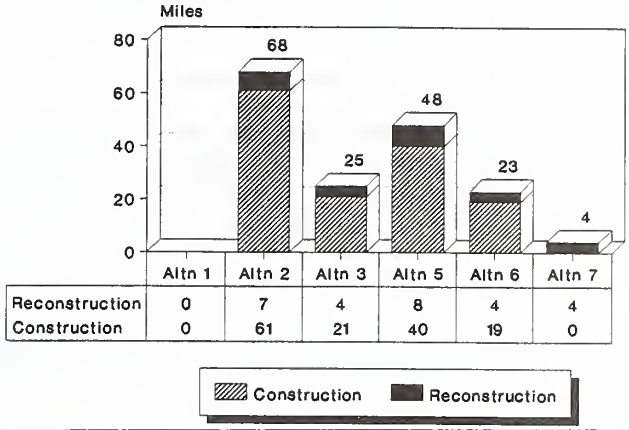
	Total Timber Base (MBF Vol.)1/	Volume Class 6 & 7 (MBF Vol.)	Proportionality (percent)	Difference (percent)2/
Management Area K32				
TTRA Baseline (on November 28, 1990)	2,120,769	789,617	37.2	
Post TTRA Harvest	1,943,069	732,155	37.7	+0.4
Alternative 1	1,943,069	732,155	37.7	+0.4
Alternative 2 3/	1,891,015	712,647	37.7	+0.5
Alternative 3	1,915,206	724,584	37.8	+0.6
Alternative 5	1,898,714	712,159	37.5	+0.3
Alternative 6	1,914,476	718,360	37.5	+0.3
Alternative 7	1,926,796	724,238	37.6	+0.4
Management Area K35				
TTRA Baseline (on November 28, 1990)	1,126,040	243,088	21.6	
Post TTRA Harvest	1,098,803	243,088	22.1	+0.5
Alternative 1	1,098,803	243,088	22.1	+0.5
Alternative 2	1,097,799	242,921	22.1	+0.5
Alternative 3	1,097,799	242,921	22.1	+0.5
Alternative 5	1,098,585	243,088	22.1	+0.5
Alternative 6	1,098,700	243,088	22.1	+0.5
Alternative 7	1,097,799	242,921	22.1	+0.5

SOURCE: Nightingale and Marks, 1996

1/ Total Timber Base volumes derived using the Transition Method of adjustment in net MBF.
2/ A positive difference indicates that the percent of Volume Classes 6 and 7 remaining in the Management Area is higher than the TTRA baseline. A negative difference indicates a lower percentage than the TTRA baseline.
3/ Project alternative volumes derived from site specific stand exam net volumes.

Road development is divided into two main categories, construction and reconstruction. Figure 2-6 shows the number of miles of new road construction and reconstruction proposed to access the harvest units for each alternative.

Figure 2-6
Proposed New Road Construction and Reconstruction



There are two existing LTFs and one new LTF required to implement the various alternatives. Alternative 2 would not utilize the Carroll Inlet LTF (road connection from Shelter Cove). Only Alternatives 2 and 5 utilize the Shrimp Bay LTF. This analysis has roughly estimated which units or groups of harvest units would most economically be hauled to a given LTF. Actual haul may be different. Table 2-5 shows the volume of harvest projected to be hauled to each LTF.

Table 2-5
Proposed Harvest, by Existing and New Log Transfer Facility, in MMBF

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Shrimp Bay	0	12	0	7	0	0
Shelter Cove	0	48	2	< 1	< 1	2
Carroll Inlet*	0	0	31	44	32	17

SOURCE: Oien, 1996

* New Log Transfer Facilities

Comparison of Alternatives by Significant Issue

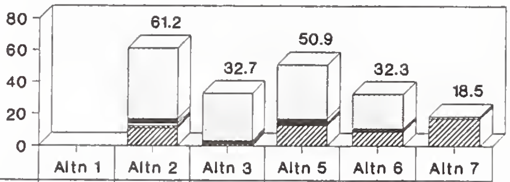
Chapter 1 presents in detail the significant issues that are the focus of this EIS and the key indicators for evaluating the impacts of timber harvest on each issue. This section compares the alternatives in terms of these issues. The baseline for comparing alternatives is Alternative 1, the no-action alternative. Chapter 3 contains the detailed evaluation of the potential effects of timber harvest and road construction activities under each alternative on forest resources.

Issue 1. Timber Harvest Economics and Supply

Logging Systems

Estimated timber economics focuses on the residual value (stumpage) of the timber after all associated logging and transportation costs are subtracted. Generally, the most expensive logging method is helicopter, followed by slackline, highlead, live skyline (shotgun), running skyline and shovel yarding. Average yarding distance, uphill versus downhill yarding, volume per acre, species composition and value, in combination with other factors, will influence the relative cost of each yarding method. Helicopter yarding is necessary in areas where it is impractical to build road or where aerial logging is necessary to meet specific standards and guidelines. Alternative 7 proposes the most helicopter volume (17 MMBF), while Alternative 3 proposes very little (1 MMBF). Figure 2-7 compares the logging systems proposed for each alternative.

Figure 2-7
Timber Harvest by Logging System



	Altn 1	Altn 2	Altn 3	Altn 5	Altn 6	Altn 7
Running/Skyline	0	44.2	29.3	33.9	21.6	1.2
Live Skyline	0	3.1	1.2	2.6	0.9	0
Slackline	0	1.4	0	0.7	0	0
Shovel	0	1.3	0.9	1	0.8	0.2
Helicopter	0	11.2	1.3	12.7	9	17.1

Helicopter · Shovel · Slackline · Live Skyline · Running/Skyline

Mid-market Value

The analysis of timber values in the Timber section of Chapter 3 looked at both the mid-market and current-market value estimates for each alternative. The current-market values are considerably higher than the average or mid-market values which indicate that: (1) consumer demand is higher; (2) timber supplies are limited; or (3) some combination of the above is true.

Alternatives 3 and 6 show a positive net stumpage at current-market values, while only Alternative 3 is positive at mid-market values. Over the last year current timber price indices have been dropping. If this trend continues, Alternative 3 will be the only economically viable alternative.

Table 2-6 compares the economics of timber harvest in dollars per thousand board feet ($/MBF) for each alternative under mid-market conditions (generally representing the average market condition and product mix) and current-market conditions. The conversion rate expresses the net dollar value of the timber volume after subtracting the production costs from the log values.

Table 2-6
Estimated Mid-market and Current-market Stumpage Value

	Alternatives					
Components	**1**	**2**	**3**	**5**	**6**	**7**
Mid-market Conversion Rate ($/MBF)	0	-158.40	+19.06	-53.64	-8.64	-17.43
Current-market Conversion Rate ($/MBF)	0	-137.42	+51.05	-33.50	+9.26	- 0.43

SOURCE: Marks, 1996

Timber Supply

The Upper Carroll Project Area is composed of moderately difficult topography from a logging standpoint. The roughly 8,000 acres of suitable ground represents well under 1 percent of the suitable lands available for harvest on the Tongass National Forest. Project specific falldown was determined to be 47 percent (see Chapter 3, Timber). This would indicate that the Project Area will contribute less volume than originally scheduled over the rotation. Conversely, it will retain more old-growth for wildlife, subsistence and other amenity values.

Public concern has been focused on the effects of falldown on community stability and the rate of harvest (ASQ) scheduled in the Forest Plan. The Forest Service has addressed this issue by incorporating updated information into the TLMP RSDEIS (1996a) which includes not only the effects of falldown, but land use allocations and revised standards and guidelines. The Ten Year Sale Action Plan included as part of FEIS Appendix A in this document has been updated to reflect these changes for both the Tongass National Forest and the Upper Carroll Project Area. The Upper Carroll project is consistent with the existing Forest Plan (TLMP, 1979 as amended) and the Standards and Guidelines for the Preferred Alternative of the TLMP RSDEIS (1996a).

In addition to the actions listed above, the Upper Carroll Project includes a range of alternatives that would harvest from 26 percent (Alternative 7) to 90 percent (Alternative 2) of the volume originally scheduled. The remaining alternatives would harvest approximately 47 percent (Alternatives 3 and 6) and 75 percent (Alternative 5) of the scheduled volume.

Issue 2. Fish Habitat and Water Quality

Best Management Practices

There is no measurable effect on water quality or fisheries production by any of the timber harvest or associated activities proposed by any of the action alternatives. All alternatives meet the requirements and intent of the Clean Water Act. Implementation of project specific stream buffers that range up to 500 feet meet or exceed the TTRA requirements to provide a minimum 100-foot buffer on Class I streams and Class II streams flowing directly into Class I streams would effectively mitigate direct stream channel impacts from proposed timber harvest and road construction. Adherence to Best Management Practices (BMPs) outlined in the Soil and Water Conservation Handbook (USDA FSH 2509.22) during the design of units and roads will minimize the potential direct effects to fish as well. Site-specific BMPs were developed and selected to minimize the potential for impact to fish habitat. These site-specific BMPs are noted on the individual Unit Design and Road Cards in FEIS Appendix K.

Habitat Capability

Fish habitat capability models are used to estimate the effects of timber harvest on the capability of streams to provide habitat for selected species of salmon and trout. Because there are many factors which influence fish populations, including commercial/sport harvest, oceanic conditions, and predation, these computer models provide only relative measures of habitat capability. These models indicate that there is no significant direct change in habitat capabilities for coho and pink salmon, or for Dolly Varden char and the species which they represent, among the alternatives including the no-action alternative.

Cumulative Watershed Effects

Every major watershed within the Project Area has experienced prior timber harvest and road construction. Reentering these drainages may generate a greater potential risk for impacts on water quality, with the risk expected to be greater in those watersheds with the higher cumulative percents of harvest. Table 2-7 shows the existing direct and indirect effects of timber harvest and road construction by third order or larger watershed during the 15-year period, 1982-1997.

Table 2-7
Cumulative Watershed Effects, Percentage of Watershed Harvested and Roaded in Third Order or Larger Watersheds

Watershed Number	Watershed Harvested and Roaded 1982-1997					
	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
C41B	0	3	0	1	0	0
C43A	0	19	0	19	0	0
C58A	0	4	0	0	0	3
D69B	0	3	1	2	2	0
D70C	0	8	5	6	5	2
D71A	0	4	8	11	3	3
D74A	0	1	0	0	0	0
D79A	10	23	22	18	18	22
D80B	0	0	0	0	0	0

SOURCE: Babik, 1996

Stream Crossings

Another measure of potential risk to fish habitat from timber harvest is the associated new road construction and road reconstruction which crosses streamcourses (see Chapter 3-Fisheries). During placement of culverts or bridges, sediment may be introduced into the streams which may have short- or long-term effects on water quality. Alternative 7 proposes the fewest stream crossings, while Alternative 2 proposes the most. This is shown in Table 2-8.

Table 2-8
Stream Crossings to be Constructed

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Class I	0	15	11	17	10	8
Class II	0	25	11	17	13	1
Class III	0	127	72	74	52	3
Total Crossings	**0**	**167**	**94**	**100**	**108**	**12**

SOURCE: Oien, 1996

Mass Movement Index (MMI)

Following timber harvest, there is an increased risk of landslides until second growth and the brush layer become firmly established. One way of analyzing this risk is to determine the amount of timber harvest on slopes which have high mass movement index (MMI) soils. This rating does not imply that such a mass-wasting event will occur; rather, it ranks the alternatives on the basis of the potential for a mass-wasting event to occur, which may or may not result in an increase in stream sediment. This increased stream sedimentation may result in some loss or impairment of resident and anadromous fish spawning and rearing habitat. Table 2-9 displays the proposed harvest on high MMI and very high MMI soils by alternative. Virtually all very high MMI soils have been removed from the timber base. Only those sites that appear to be small inclusions or mistyped have been retained in the unit pool. These sites have been examined by a professional soil scientist as part of unit reconnaissance.

Table 2-9
Acres of High Hazard Soils Harvested by Alternative

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
High MMI soils	0	520	245	455	231	107
Very High MMI soils*	0	0	0	0	0	0

SOURCE: Babik, 1996

* See Chapter 3-Soils for details of MMI classifications.

Sediment Transfer and Deposition

The Carroll Creek and Neets Creek watersheds were evaluated for sediment delivery and depositional potential using a watershed-level analysis (Geier and Loggy, 1995). The watersheds were divided into sub-basins and reaches. Sediment transport and deposition indices were developed based upon watershed morphology, discharge, and potential sediment sources (for a detailed description of this process see FEIS Appendix F, Sediment Transfer and Deposition Analysis Procedure). This sediment transfer index indicates where in a watershed sediment production and deposition is a potential problem for maintenance of aquatic habitat. The quantity of sediment transported and deposited depends upon a number of factors, including nature of sediment source, stream discharge, and channel morphology. These are factors that resource managers must consider when they undertake activities on areas that are linked to important aquatic habitat.

Results of this sediment transport and deposition risk assessment for roads and units in the Upper Carroll action alternatives indicate that Alternatives 7, 6 and 3 have a lower overall risk of sediment delivery to streams. Alternative 7 harvests the least acres, avoids new road construction, utilizes helicopter logging, and avoids most sensitive areas. Alternative 3 reduces overall risk by minimizing harvest unit location and road construction near stream courses in high risk sub-basins and proposing no activities in Neets Creek watershed, and in the west fork of Carroll Creek. Alternative 6 is generally similar to Alternative 3 except that it makes a helicopter entry into the west fork of Carroll Creek. This is somewhat offset by avoiding several units with high sediment deposition index (SDI) ratings in Sub-basin S04. Alternative 5 presents a higher risk of producing sediment that may affect beneficial uses, mainly by proposing road construction and timber harvest in the west fork of Carroll Creek along with helicopter logging in Neets Creek. Alternative 2 poses the highest risk of sediment delivery from road related sediment. It also proposes a number of timber harvest units and roads in the west fork of Carroll Creek, plus the Neets Creek watershed.

Issue 3. Recreation and Scenic Quality

Scenic Quality

There are 3 key viewsheds within the Project Area. The proposed visual quality objectives (VQOs) for this project establish the minimum visual quality management standards for these key viewsheds.

Table 2-10 displays the proposed VQOs for each key viewshed and the determination of consistency for each alternative. Alternative 1 represents the existing visual condition. In all viewsheds for all alternatives, the proposed harvest units achieve the proposed visual quality objectives.

Table 2-10
Consistency with Forest Plan Visual Quality Objectives

Viewshed	Proposed VQO*	Meets Visual Objective Alt.1**	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Carroll/Shelter Cove	PR-M	Yes	Yes	Yes	Yes	Yes	Yes
Carroll Estuary	PR-M	Yes	Yes	Yes	Yes	Yes	Yes
Head of Neets Bay	PR-M	Yes	Yes	Yes	Yes	Yes	Yes

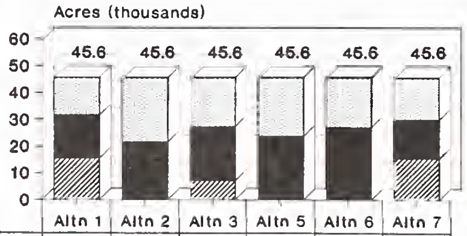
SOURCE: Angelus, 1996

* R = Retention; PR = Partial Retention; M = Modification; MM = Maximum Modification
** Alternative 1 represents the existing condition

Recreation Opportunity Spectrum (ROS)

Implementing any of the action alternatives will change the existing Recreation Opportunity Spectrum (ROS) class within the Project Area. Figure 2-8 shows the change in ROS class by alternative.

Figure 2-8
Changes in ROS Class by Alternative

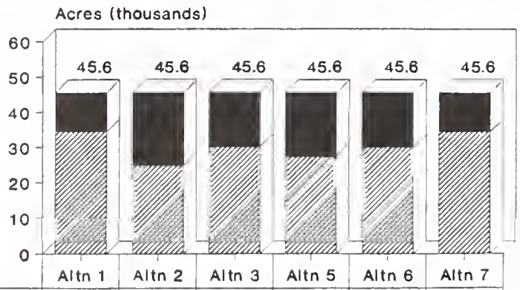


	Altn 1	Altn 2	Altn 3	Altn 5	Altn 6	Altn 7
Roaded Modified	14	24.1	18.4	21.9	18.6	15.6
Semi-Prim Non-Motor	16.3	21.5	20.1	23.7	27	14.7
Primitive	15.3	0	7.1	0	0	15.3

Roadless Areas

The TLMP Draft Revision (1991a) identified two roadless areas which lie within or partially within the Project Area. The impact of timber harvesting on roadless areas is much larger than the acres harvested because the sights and sounds associated with the harvest activity affect the surrounding area. Roadless areas generally need to be at least 5,000 acres in size to be considered roadless. Figure 2-9 shows the number of roadless area acres that will remain after implementation of an alternative.

Figure 2-9
Timber Harvest within Roadless Areas



	Altn 1	Altn 2	Altn 3	Altn 5	Altn 6	Altn 7
Roaded Acres	11.2	20.7	15.4	18.2	15.6	11.2
Roadless Acres	34.4	24.9	30.2	27.4	30	34.4

Issue 4. Wildlife Habitat

The major effect on wildlife habitats in all action alternatives is the reduction of old-growth forest habitat. Impacts to other habitats were reduced by the interdisciplinary design of units prior to alternative formulation. All alternatives result in impacts consistent with the implementation of the TLMP (1979a, as amended) and the Preferred Alternative of the TLMP RSDEIS (1996a), Standards and Guidelines.

Table 2-11 displays the potential reduction in wildlife habitat capabilities, as estimated by habitat capability models, for the key Management Indicator Species (MIS) found in the Upper Carroll Project Area. This table displays the 1954 long-term habitat capability and estimated short-term reduction in habitat capability after potential implementation of the alternatives.

Table 2-11
Potential Changes in Habitat Capability within the Project Area for MIS in 1997

Species	Habitat Capability		Changes from 1995 by Alternative					
	1954	1995	1	2	3	5	6	7
Sitka black-tailed deer*	629	389	0	-32	-18	-25	-22	-13
black bear	75	70	0	-4	-3	-3	-3	-2
otter	26	17	0	-1	-1	-1	-1	-1
marten	58	44	0	-5	-3	-4	-3	-2
hairy woodpecker	501	341	0	-38	-21	-30	-23	-16
Vancouver Canada goose	86	74	0	-7	-6	-7	-6	-5
bald eagle	54	40	0	0	0	0	0	0
brown creeper	993	497	0	-53	-29	-42	-29	-20
red squirrel	24,637	22,714	0	-1,488	-824	-1,160	-856	-536
grey wolf	2.3	1.5	0	0	0	0	0	0

SOURCE: Burns, 1996

Note: Numbers do not incorporate patch size effectiveness calculations (see the Old Growth/ Biodiversity section)

* Deer habitat capability figures assume an index value of zero for units immediately following harvest.

Forest fragmentation represents a change in the overall forest landscape from large, contiguous blocks of old-growth forest to smaller blocks separated by timber harvest units. Increased amounts of forest fragmentation indicate reduced habitat potential for species which are thought to be dependent on interior old-growth forest habitat. One way to analyze forest fragmentation is to measure the reduction of large, contiguous blocks of old-growth forest as a result of timber harvest. Large and medium sized blocks of old growth (Naha Roadless Area, Misty Fiords National Monument, Traitor's Cove Retention, Orchard Lake, and Swan Lake) are adjacent to the Project Area. In addition, the Project Area contains a significant amount of old-growth habitat in blocks over 1,000 acres in size. Table 2-12 displays the number of acres of old-growth habitat in large blocks that will remain after implementation of an alternative.

Table 2-12
Effect of Timber Harvest on Forest Fragmentation in Acres

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Acres of large, unfragmented blocks 100-500 acres remaining after harvest	2,243	3,492	3,329	3,607	2,920	3,027
Acres of large, unfragmented blocks 500-1,000 acres remaining after harvest	2,270	5,881	4,381	6,282	4,058	4,601
Acres of large, unfragmented blocks >1,000 acres remaining after harvest	11,735	4,563	7,135	4,494	7,940	7,724
Total Acres of Old-Growth remaining after harvest	**17,641**	**15,644**	**16,567**	**16,023**	**16,609**	**17,050**

SOURCE: Burns and Nightingale, 1996

Note: Old-growth includes only Volume Class 4 and above.

A portion of the Naha old-growth habitat block extends outside of the LUD II area into the Project Area (see Figure 2-1). This portion of the block is designated as a LUD IV under the current Forest Plan and is available for timber harvest. Alternative 2 and 7 propose to harvest two units totaling 48 acres within this old-growth block. The remaining alternatives do not propose any harvest within this block primarily for economic and wildlife management reasons.

The west side of Carroll Creek represents a small block of unfragmented old-growth habitat located inside the project boundary (see Figure 2-1). The southwest portion of this area is adjacent to the Naha Block. Alternatives 3 does not propose any harvest within this block primarily for economic and wildlife management reasons. Alternative 7 would harvest a very minor amount of timber (43 acres). Alternatives 2, 5 and 6 would harvest 302, 317 and 237 acres respectively from the Carroll Creek block.

Late successional corridors approximately one-quarter mile wide (see Figure 2-1) that provide connectivity between core areas of unfragmented old-growth habitat were identified. These corridors contain 2,737 acres of which 799 acres are not commercial forest land. Alternative 2 would impact the corridors to the largest degree (73 acres), followed by Alternative 5 and 6 (60 acres), Alternative 3 (25 acres), and Alternative 7 (1 acre). The TLMP RSDEIS (1996a), Preferred Alternative Standards and Guidelines proposes travel corridors of approximately 600 feet in width. No timber harvest is proposed under any of the action alternatives that would result in a travel corridor being less than 600 feet wide.

Issue 5. Subsistence Use

Chapter 3 evaluates the potential site-specific effects on subsistence that could result from implementing any of the proposed timber harvest and associated road construction alternatives.

The Tongass Resource Use Cooperative Survey (TRUCS) identified areas which are most heavily used by subsistence households. Based on the TRUCS, the Project Area contains no high or moderate use subsistence areas. High and moderate use is interpreted to mean greater than 50 households ever used the area for subsistence deer hunting.

Deer hunting is one aspect of subsistence use affected by timber harvest. The Wildlife and Subsistence sections of Chapter 3 discuss the computer models used to estimate the effects of timber harvest on deer habitat capability, both long range and short range. Based on this analysis, Alternative 1 will cause no reduction of deer habitat capability. Among the action alternatives, Alternative 7 would cause the least reduction to deer habitat capabilities, while Alternative 2 would reduce deer habitat capabilities the most within the Project Area; although all action alternatives result in less than a one percent reduction in the current habitat capability for both WAAs.

Table 2-13 displays the percent of 1954 deer habitat capability the WAAs (406 and 510) can support now and at the end of the KPC Long Term Sale (2004). The full WAA habitat capability has not been reduced for the effects of fragmentation.

Table 2-13
Percent of 1954 Deer Habitat Capability for WAAs 406 and 510

Alternative	Percent of 1954 Habitat Capability		Percent of 1954 Habitat Capability Needed to Meet Current Demand
	1997	2004	1995
1	81	78	19
2	81	78	19
3	81	78	19
5	81	78	19
6	81	78	19
7	81	78	19

SOURCE: Burns, 1996

Note: Habitat capability for entire WAAs has not been reduced for fragmentation.
Habitat capability assumes the harvested units are converted to the clearcut stage (0-25 years).
Habitat capability in 2004 assumes full implementation of the Forest Plan for all alternatives (maximum timber harvest within standard guidelines—no reduction for economic constraints.

The Project Area is located within portions of two Wildlife Analysis Areas (WAA), 406 and 510. The harvest is 104 deer per year based on ADF&G hunter surveys for both complete WAAs. Approximately 19 percent of the original (1954) habitat capability is needed to support this level of deer harvest. Currently (1995) the two full WAAs provide 81 percent of the original habitat capability for deer. The habitat capability through the year 2004 is projected to be approximately 78 percent of the original (1954) habitat capability.

Competition for subsistence resources in the Project Area is a scoping issue. Subsistence users are concerned with competition from residents of Ketchikan. Since Ketchikan residents are considered non-rural, this competition can be regulated if it starts to restrict rural residents' ability to obtain subsistence resources. In the Wildlife Section, the cumulative analysis discussed a potential road connection between the Project Area and the Ketchikan road system. If such a connection is made, it would significantly increase the amount of rural and non-rural use of the area and could increase the amount of competition to the point that there could be a significant restriction in subsistence use of deer and marten in the Project Area.

The Federal Subsistence Board may use its authority to regulate non-rural harvest of deer and has authority to prioritize the harvest of deer among rural residents when necessary to protect the resource. The current deer population level does not require restrictions on non-rural users.

There is no evidence to indicate that availability of salmon, finfish, shellfish, or other food resources to subsistence users would be affected by sport or non-rural harvest. Any increase in competition from non-rural Alaskan residents and nonresidents would not be substantial because of the availability of resources in the immediate vicinity and in the surrounding areas.

The above analysis indicates that the actions proposed in Alternatives 2 through 7 will not represent a significant possibility of a significant restriction on subsistence use of deer, black bear, or otter in the Project Area. Marten harvest in WAA 510 is at the peak of the level that can be sustained. Increasing human population coupled with future reductions of habitat capability for deer, marten, and wolf, and in light of the fact that Saxman residents' use of the area is under-reported for the Project Area, there may be a significant possibility of a significant restriction of subsistence use of deer, marten, and wolf at some point in the future (next 150 years) for all alternatives including the No Action Alternative.

Issue 6. Transportation/Utility Corridor

The Tongass Land Management Plan Revision team has mapped the transportation and utility corridors on the Tongass National Forest. The maps show two corridors passing through the Project Area. The Alaska Legislature passed Senate Joint Resolution 40 during the 1992 session. This resolution urges the Forest Service to avoid actions which would preclude the use of any of the transportation and utility corridors identified by an interagency group.

The Upper Carroll Project Area contains approximately 30 to 40 miles of the various potential routes identified to date. The IDT reviewed the possibilities of action being taken on the transportation and utility corridors in the foreseeable future. The review indicated that the corridor could be used for electrical transmission lines within the next decade. The review concluded that the road connections proposed are unlikely within the foreseeable future and that no actions proposed under any alternative would preclude use of any of the transportation and utility corridors.

The "Lake Tyee to Swan Lake Transmission Intertie" (R.W. Beck and Associates, 1992) presents a feasible electric power transmission line route within the Project Area. The preferred route identified in the R.W. Beck study passes through the Project Area by way of Carroll Creek and Neets Creek drainages. Ketchikan Public Utilities has awarded a contract to Foster Wheeler Environmental Corporation to complete an EIS for the proposed electrical intertie. A DEIS was issued in March 1996. The initial routes through the Project Area have remained essentially unchanged (Figure 2-10).

The Ketchikan Gateway Borough and the Alaska Department of Transportation and Public Facilities cooperated in an examination of highway corridor opportunities. This study, *Ketchikan - Revillagigedo Island Corridor Study* (R&M Engineering, 1992), identified a preferred highway route that passes through the Project Area along the west side of Carroll Inlet, then north along Carroll Creek until the junction with Neets Creek and Orchard Creek. At this point one potential route heads north outside the Project Area toward Orchard Lake, the other route follows Neets Creek before heading north to Shrimp Bay. As part of the Upper Carroll field reconnaissance, the Forest Service located and flagged on the ground the preliminary route from Shelter Cove to Shrimp Bay. This alternative route uses a ferry terminal at Shrimp Bay as an alternative to the route on the north side of Orchard Lake and some very difficult highway building terrain north of Shrimp Bay.

The IDT considered these routes in alternative formulation and also evaluated them for likelihood of construction within the foreseeable future through other means. For the purpose of this analysis, the reasonably foreseeable time frame over which the indirect effects are estimated is until the end of the Ketchikan Pulp Company (KPC) Long-term Contract (the year 2004). This determination of reasonably foreseeable is based on the time frame of the KPC contract commitment.

Based on the feasibility and likelihood of findings for power transmission projects within Alaska, the IDT concluded that the construction of the Swan Lake to Lake Tyee powerline was likely within the foreseeable future.

The effects of the possible construction of the power line within the Project Area have primary effects on the visual resource. The clearing of the corridor along the transmission lines would be seen from a number of view points.

The actions proposed in the Project Area could potentially benefit the transmission project by incidental transportation and logistics uses. The construction of the transmission lines across National Forest lands normally requires removal of all merchantable timber felled along the corridor. The road system will allow shorter flights for helicopters removing the timber which would reduce costs. The roads will also allow shorter transportation by helicopter for towers, cable, and other logistics. This activity is expected to result in a reduction of costs. Table 2-14 displays the miles of road that would be constructed or reconstructed that could potentially serve as access to a possible utility corridor or eventually as a transportation link within the Project Area under each alternative.

Table 2-14
Potential Transportation/Utility Corridor Access Miles

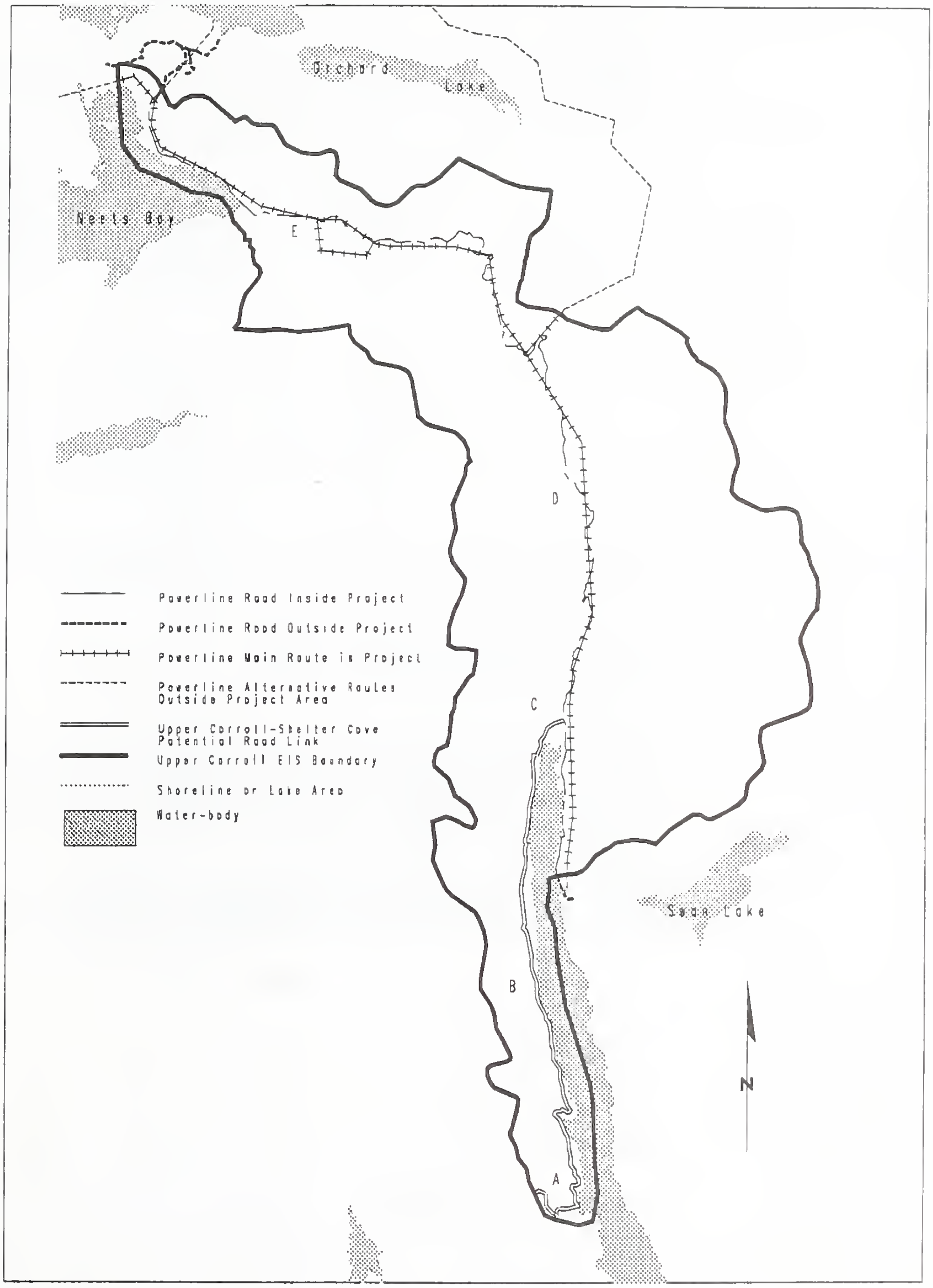
Alternative	Utility Corridor Miles	Transportation Link Miles
1	0	0
2	23.2	31.9
3	6.5	4.2
5	8.9	6.8
6	8.9	6.8
7	2.7	0.4

SOURCE: Nightingale and Oien, 1996

Based on the historical nature of state highway development in Southeast Alaska and limited funding, the IDT concluded that a road connection would not reach the Project Area within the foreseeable future.

The IDT evaluated the action alternatives as requested by Senate Joint Resolution 40, and determined that none of the action alternatives will preclude the identified transportation and utility corridors within the foreseeable future.

Figure 2-10
Proposed Utility Corridor



Issue 7. Social and Economic Effects

The State of Alaska receives 25 percent of the sum of all net receipts from timber sold on National Forest System Lands plus any purchaser road credits. This money is earmarked for public school and road maintenance funding. Table 2-15 shows the estimated returns to the State of Alaska and the Ketchikan Gateway Borough from the harvest of timber (from this project only) by alternative. Actual returns will be based upon sale volumes and appraised rates and may differ from this estimate, which is based on mid-market rates.

Table 2-15
Estimated Returns to State of Alaska from Sale of Timber*

Alternative	Estimated volume (MMBF)	Total receipts ($Millions)	State of Alaska returns ($Millions)	Ketchikan (KGB) returns** ($Millions)
1	0	0	0	0
2	64	13.273	3.318	.149
3	34	8.110	2.208	.091
5	53	11.660	2.915	.131
6	33	7.033	1.758	.079
7	19	0.710	0.118	.008

SOURCE: Marks, 1996

* Based on mid-market rates timber receipts.
** Based on historical average percent distribution.

Table 2-16 displays the employment (jobs) and personal income (salaries) associated with each alternative **averaged over a four-year period.** The jobs and salaries listed include those both directly and indirectly dependent upon the timber industry.

Table 2-16
Timber Industry Average Annual Employment and Income by Alternative

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Volume Harvested Total (MMBF)	0	64	34	53	33	19
4 Year Avg (MMBF)	0	16	9	13	8	5
Employment (Jobs)	0	119	65	99	63	36
Personal Income (Millions$)	0	4.5	2.5	3.8	2.4	1.4

SOURCE: Marks, 1996

All Alternatives provide volume, in combination with other scheduled offerings, to help meet short-term contractual obligations to KPC and/or assist the independent timber purchasers in maintaining timber-related employment in the region. In these alternatives, the total volume (including ROW volume) harvested ranges from 19 MMBF in Alternative 7 to 64 MMBF in Alternative 2. Alternatives 3, 5 and 6 provide 34 MMBF, 53 MMBF, and 33 MMBF respectively. These volumes could be provided to KPC in harvest offerings that would meet contract requirements and maintain volume for continued mill operations. They could also be sold to independent timber purchasers.

Under Alternative 1, the no-action alternative, none of the employment described above would be supported by timber harvest activity in the Upper Carroll Project Area. This would result in a negative effect on timber harvest employment should local timber purchasers not be able to substitute volume from another source. The effects of Alternative 1 are not predictable and could range from elimination of shifts to partial or even full shutdown of the local mills for an unspecified period of time. Selection of the no-action alternative could also have potential long-term ramifications to the contract holder, the core communities, and ultimately Southeast Alaska, through de-stabilization of the wood products industry.

The projected long-term effects of different harvest levels are contained in the TLMP RSDEIS (1996a). This analysis includes falldown factors such as additional streams, blind leads, unsuitable soils, and a variety of other factors.

None of the alternatives is expected to have a significant direct impact on the commercial fishing, recreation, and tourism industry or related employment.

Issue 8: Marine Environment

Direct effects to the marine environment are assumed to occur only from development and use of LTFs, and are limited to the intertidal area affected by rock fill and either the intertidal or subtidal areas potentially affected by accumulations of bark debris.

A total of 5 potential LTF locations were considered for possible development. There are 4 existing LTF sites and 1 potential new site. The maximum number of LTFs that would be utilized under any alternative is 3 (1 new site and 2 existing sites), as there are several possible sites considered for each road system. The final selection of which LTF sites to utilize was based on the interagency guidelines (Alaska Log Transfer Facility Siting, Construction, Operation, and Monitoring/Reporting Guidelines). The U.S. Fish and Wildlife Service and the National Marine Fisheries Service staff conducted subtidal surveys at the sites that appeared to best meet the interagency guidelines. The subtidal survey reports and recommendations which are included as part of Appendix G, were used to further define which of the potential LTF locations were preferable. Table 2-17 displays the LTFs involved in the various alternatives. See also the detailed alternative maps included with the Upper Carroll EIS.

Table 2-17
Log Transfer Facilities Required, by Alternative and System

LTF Name	LTF Site #	Alternative 1	2	3	5	6	7	LTF System
Shrimp Bay	1	N	I	N	I	N	N	A Frame
Shelter Cove	3	N	I	I	I	I	I	A Frame
Carroll Inlet #7	4*	N	N	I	I	I	I	Low Angle Ramp

SOURCE: Oien, 1996

I = Planned for intermittent use; N = Not planned for use. *New Log Transfer Facilities

Table 2-18 displays the number of LTFs used or developed, the total acreage of the structural embankment, and the estimated acres to be affected by bark deposition. The combination of the marine habitat covered by the structural embankment and the area potentially covered by bark deposition represents the total loss of marine benthic habitat for each alternative.

Table 2-18
Marine Benthic Habitat Affected by Alternative

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Existing LTF Sites	2	2	2	2	2	2
Proposed New LTF Sites	0	0	1	1	1	1
Structural Embankment (Acres Affected	0.5	0.5	0.7	0.7	0.7	0.7
Bark Deposition (Acres Affected)	2.0	2.0	3.0	3.0	3.0	3.0
Total Acres of Marine Benthic Habitat Affected	**2.5**	**2.5**	**3.7**	**3.7**	**3.7**	**3.7**

SOURCE: Oien, 1996

The No-action Alternative and Alternative 2 would have no measurable additional effect on the marine environment, while Alternatives 3, 5, 6, and 7 affect the marine system (3.7 acres) in a similar fashion. The loss of habitat is much less than one percent of the available marine habitat in the Project Area. Since all species identified along the subtidal (underwater) survey transects are common throughout Southeast Alaska, it is concluded that there would not be a significant impact to the marine environment from constructing (or continuing to use) LTFs at the proposed sites.

Mitigation

TLMP Mitigation

The Forest Service uses numerous mitigation and preventive measures in the planning and implementation of land management activities. The application of these measures begins during the planning and design phases of a project. They link to the overall Forest, Ketchikan Administrative Area, and Ranger District management direction and continue through all phases of subsequent forest management. The standards, guidelines, and direction contained in the current TLMP (1979a), the TLMP RSDEIS (1996a), Alaska Regional Guide, and applicable Forest Service manuals and handbooks have been applied in the development of alternatives and design of harvest units and roads.

Public comment on the Upper Carroll DEIS was helpful in identifying when and where additional mitigation measures should be considered. Listed below is a brief summary of some of the mitigation measures common to all alternatives. Specific mitigation measures, as applied to each individual unit, can be seen in the "As Planned" Unit Design and Road Cards. These unit and road cards are an important tool for implementing the project, as they list standards and guidelines and provide a mechanism for tracking project implementation. Unit Design and Road Cards have been developed for each individual unit that occurs in an alternative and appear in FEIS Appendix K.

Water Quality and Fish Production

TTRA, BMPs, Water Quality

Mitigation to protect water quality, fish habitat, and wetlands includes application of the Best Management Practices (BMPs) stated in the Soil and Water Conservation Handbook (USDA FSH 2509.22). This handbook provides standard operating procedures for all stream classes. In addition, the TTRA mandates a minimum 100-foot buffer on all Class I streams and on Class II streams that flow directly into Class I streams. The width of this buffer strip may be greater than 100 feet for reasons such as topography, riparian soils, a windfirm boundary, timber stand boundaries, logging system requirements, and varying stream channel locations. In addition, certain Class III streams flow directly into or have been identified as influencing Class I streams. These Class III streams have been buffered to the slope break of the channel or to a windfirm boundary to protect water quality. Split yarding or full suspension was built into the logging and transportation design process, as was partial and full suspension over wetland soils or soils with a higher mass movement potential. Direct in stream impacts are minimized through road construction timing and fish passage requirements on certain Class I and II streams. Refer to FEIS Appendix F (Watershed Report) for the rationale and to Appendix K (Unit Design and Road Cards) for the unit-specific stream buffering, suspension, passage, and timing requirements being applied. Application of BMPs and adherence to the TTRA requirements will protect water quality fish habitat and wetlands as well as riparian habitat important to other species such as deer, bear, and furbearers.

While required buffers will mitigate most temperature sensitivity concerns, there still is concern about providing topographic shading to Class III streams that flow through harvest units. Unit 16 has characteristics (south aspect, lack of immediate downstream forested stream buffers, historical, and continued harvest activities, etc.) that may contribute to the temperature sensitivity of nearby streams. Following completion of the watershed analysis, buffers were placed on streams as needed to meet water quality objectives including water temperature.

Wildlife

Harbor Seals, Trumpeter Swans, and Other Wildlife

Mitigation measures to protect wildlife habitat are a part of the design of the alternatives, including the location of the harvest units and roads. Harvest units and roads are intentionally located away from important wildlife habitats (to the extent practicable) to reduce the effects on wildlife. Beach and estuary habitats are completely avoided by harvest units, while road incursions are minimized to the extent practicable. Where possible, disturbance of important travel corridors is minimized to allow the undisturbed movement of wildlife. Other specific mitigation measures include:

1. Provide habitat requirements for cavity and snag-dependent wildlife species by retaining reserve trees within all land use designations as outlined in the TLMP RSDEIS (1996a). To provide for adequate distribution of snags within VCUs which have marginal numbers of snags, the following units will have small 0.1-acre (or larger) snag patches distributed throughout the unit at a rate of 0.1 acre per 10 acres of unit. The location of these snag patches will be determined during layout or sale administration, and will be designed in such a fashion as to not impose undue safety hazards on logging contractors. Guidelines for placement of snag patches and old-growth islands include:

   - Areas where wildlife use is concentrated (determined during reconnaissance).
   - Selected areas should be at least 100 feet away from unit boundary (unless the unit boundary is an existing second-growth stand; then the patch or island can be placed along the unit boundary).
   - Patches or islands can be placed along split yard sections of harvest units, particularly split yard streams.
   - Snag patches or old-growth islands can be incorporated into stream buffers.
   - Snag patches or old-growth islands can be placed along boundaries of muskegs.

   Units which will employ these snag recruitment techniques include:

13	76
20	83
53	95

Goshawks

Region 10 goshawk management guidelines in effect at the time of unit release will be followed. Goshawk guidelines in the TLMP RSDEIS (1996a) call for maintaining the following conditions:

Nest Stand–Maintain an area of at least 25 acres around the confirmed nest tree (and probable nest tree if identified) and attempt to include prey handling areas, perches, and roosts. Vegetative structure objectives generally include a multi-layered, closed (over 60 percent) forest canopy, a relatively open understory, with large trees (usually 20+ inches DBH) and low ground vegetation. These structural characteristics generally equate to Volume Class 5 and higher in the timber resource inventory.

Management–No vegetative manipulation or new road construction is permitted. Existing roads may be maintained. Permit no continuous disturbance likely to result in nest abandonment within the surrounding 600 feet from March 15 to August 15. Activity restrictions are removed for active nests that become inactive or unsuccessful.

Nesting Habitat−Maintain an area of not less than 75 acres surrounding the nest stand (total management of 100 acres). Include inactive nest stands, hiding cover and foraging opportunities for young goshawks. Vegetative structure is similar to the Nest Stand but may include some intermediate canopy (e.g. Volume Class 4).

Management−No commercial timber harvest is permitted within the Nesting Habitat. New Road construction is permitted (outside the nest stand) if no other reasonable roading alternatives outside the mapped Nesting Habitat exist.

All new nests discovered during field reconnaissance or unit layout will be protected from timber harvest and blowdown by implementing the above measures or the Region 10 goshawk management guidelines in effect at the time of unit release.

Marbled Murrelets

Due to the limited information available on nesting habitat requirements of marbled murrelets, any nests located during field reconnaissance or unit layout will be assessed on a case-by-case basis.

A 600-foot, generally circular, radius of undisturbed forest habitat surrounding identified murrelet nests will be maintained. Disturbance activities within this buffer will be minimized during the nesting season (May 1 to August 15). The Buffer zone will be maintained and the site monitored for nesting activity for not less than two nesting seasons after nest discovery. The buffer protection may be removed if the site remains inactive for two or more consecutive nesting seasons.

Trumpeter Swans

Timber harvest units that are within a half mile of Neets Bay and Carroll Inlet estuaries will allow harvest and road construction activities from April 1 to October 31. During the remainder of the year, harvest and road construetion may occur if swans are not present. This affects the following units:

1	29	43	110
13	30	47	113
14	35	48	
17	37	90	
24	38	104	
27	40	106	
28	41	107	

Log transportation (hauling) and LTF operation within a half mile of Carroll Creek estuary would be prohibited during January and December of each year.

Bald Eagle Nests

Road construction activities that are within a half mile of bald eagle nests will usually have blasting restricted to the period of September 1 to February 28. If the nest is unoccupied, normal blasting procedures are also permitted from June 1 to August 31, if there is no direct danger to eagles, nests, eagle nest trees, or other eagle habitat elements. Blasting within one-half mile of an active eagle nest is only allowed if: (1) the blasting can be accomplished in accordance with the requirements of the Bald Eagle Protection Act; (2) written coordination with the U.S. Fish and Wildlife Service has occurred; and (3) the results of the interagency coordination is documented.

Whale Habitats

The following Forest-wide Standards and Guidelines have been developed for application on all Forest Service permitted or approved activities and have been incorporated by reference into the Upper Carroll DEIS from the TLMP RSDEIS (1996a):

- Provide for the protection and maintenance of whale habitats.
- Ensure that Forest Service permitted or approved activities are conducted in a manner consistent with the Marine Mammal Protection Act, the Endangered Species Act, and National Marine Fisheries Service regulations for approaching whales, dolphins, and porpoise. "Taking" of whales is prohibited; "taking" includes harassing or pursuing or attempting any such activity.

Marine Mammals

Forest-wide Standards and Guidelines direct the Forest Service to prevent and/or reduce potential harassment of sea lions and other marine mammals due to activities carried out by or under the jurisdiction of the Forest Service. These have been incorporated by reference into the Upper Carroll DEIS from the TLMP RSDEIS (1996a). These Forest-wide Standards and Guidelines to provide for protection and maintenance of harbor seal, Steller sea lion, and sea otter habitats are as follows:

1. Ensure that Forest Service permitted or approved activities are conducted in a manner consistent with the Marine Mammal Protection Act and the Endangered Species Act. Taking'' of marine mammals is prohibited; taking includes harassment, pursuit, or attempting any such activity.

2. Locate facilities and concentrated human activities requiring Forest Service approval as far from known marine mammal haulouts, rookeries and known concentration areas as practicable. The following distances are provided as general guidelines for maintaining habitats and reducing human disturbance:

    - Facilities, camps, LTFs, campgrounds and other developments should be located one mile from known haulouts and farther if the development is large.

    - Individuals associated with Forest Service permitted or approved activities will not intentionally approach within 100 yards, or otherwise intentionally disturb or displace any hauled-out marine mammal.

    Several harbor seal haulout areas have been identified near the Project Area. They include:

    - rocks north side of Neets Bay
    - island in bay north side of Neets Bay
    - a rock within salt chuck north side of Neets Bay
    - Shrimp Bay cove

Waterfowl

The Standards and Guidelines for waterfowl from the TLMP RSDEIS are incorporated by reference into the Upper Carroll EIS. Significant waterfowl areas include Carroll Inlet Estuary, and Neets Bay. These habitats will be maintained through the protection of the 1000 foot estuary buffer. Activities are located as far from these areas as feasible. Disturbance to waterfowl will be minimized by the mitigation for protecting trumpeter swans.

Heron and Raptor Nest Protection

- Any active heron rookeries or raptor nests will be protected with a 600 foot windfirm buffer of old-growth habitat. Disturbance will be minimized during the active nesting season (Generally March 1 to July 31) on a case by case basis.

- The nests will be monitored annually for two years after discovery of the active nest. If the nest remains inactive for two consecutive years, protection measures for the site will be removed.

Alexander Archipelago Wolf

- A 600-foot windfirm buffer will be maintained around active wolf dens. Road construction within the buffer will be discouraged and alternate routes explored.

- The den will be monitored for at least 2 consecutive years and if the den becomes inactive, then buffer restrictions can be removed.

Mountain Goat

- Aircraft flights, including helicopter yarding of timber, will seek to avoid mountain goat kidding areas from May 15 through June 15. Flights should maintain a 1500 foot vertical or horizontal distance from traditional summer and kidding areas and animals.

- Restrict blasting within one mile of known mountain goat kidding areas from May 15 through June 15.

Subsistence
Because most subsistence use involves harvesting fish and game, mitigation measures that protect or enhance fish and game resources will also protect and enhance subsistence activities. By placing units and roads away from beach and estuary fringe habitats, and away from salmon bearing streams, mitigation measures were built into each of the alternatives considered in the EIS. Road management objectives (closures) were also heavily influenced by the desire of subsistence hunters to limit access.

Recreation
Effects of timber harvest on views from anchorages and known recreational day use areas will be reduced by leaving buffers of timber along the beaches and inland lakes. The proposed visual quality objectives for this plan emphasize the protection of the visual resource as viewed from saltwater, particularly in Neets Bay and Carroll Inlet. Protecting these viewsheds will reduce the direct effects on visual quality. Stream riparian buffers will protect fisheries habitat and sport anglers use of class I and II streams in the Project Area.

Cultural Resources
Potential effects on cultural resources can be minimized by excluding project activities from most high probability areas (exceptions are LTFs, camps, a small number of units, and access roads to these facilities). The high probability areas were all surveyed in 1994 and 1995, except for exact road locations which cannot be precisely determined until after unit and road layout occurs. Types of mitigation measures include avoidance, protective enclosures, monitoring of harvest activities, restrictions on size or road location, and recovery and documentation of materials.

Sensitive Plants

Choris Bog Orchid (Platanthera chorisana) is a designated sensitive species. Six populations of this species were discovered in muskeg openings during botanical surveys of the Project Area conducted in 1995. Populations were found within the vicinity of harvest Units 20 and 59 and adjacent to a small pond in the Carroll Creek drainage. The primary risk of perturbation to these populations would be through road construction activities. Road locations have been adjusted to avoid direct impacts to known locations of Choris Bog Orchid.

Monitoring

Monitoring activities can be divided into three broad categories: Forest Plan monitoring, routine implementation monitoring, and project-specific effectiveness monitoring. These broad types are discussed in the following sections.

Forest Plan Monitoring

The National Forest Management Act requires that National Forests monitor and evaluate their forest plans (36 CFR 219.11). The significance of this requirement is emphasized by the recent development of a National Monitoring and Evaluation Strategy (Forest Service 1993). The Strategy is designed to focus agency attention and resources on evaluating implementation of forest plans to provide the Forest Service with information necessary to ensure responsive and efficient management of National Forests. Embodied in the National Monitoring and Evaluation Strategy are three principles: (1) evaluation of results will be readily available to the public, agencies, and other groups; (2) monitoring and evaluation will focus on ecosystems and emphasize interrelationships among biotic and abiotic components; and (3) the strategy will be flexible to meet local needs while encompassing forest, regional and national requirements.

Three levels of monitoring are incorporated into Forest Plan monitoring and evaluation.

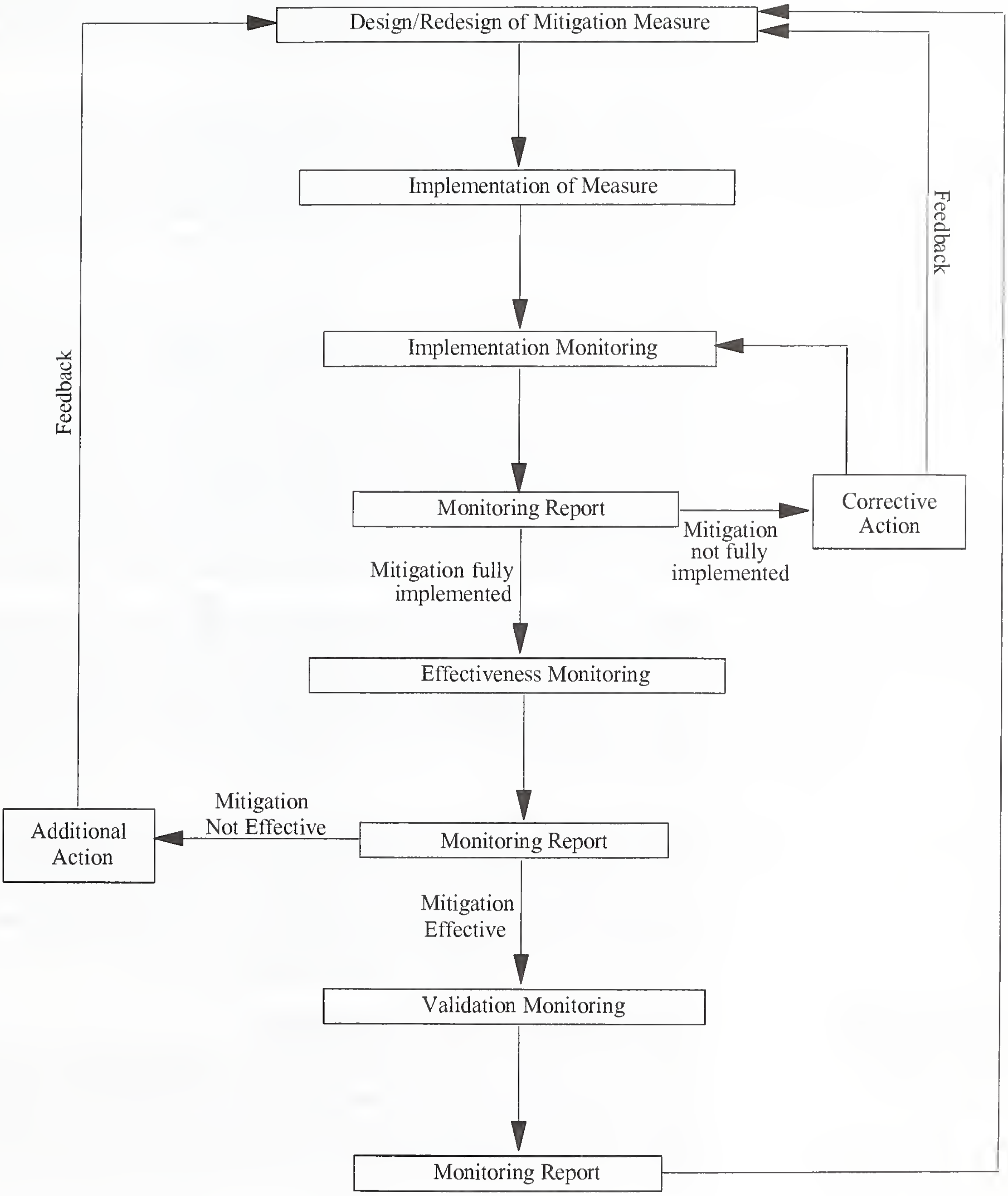
Implementation Monitoring is used to determine if goals, objectives, standards and guidelines, and management prescriptions are implemented as detailed in the Forest Plan and project specifications;

Effectiveness Monitoring is used to determine if goals, objectives, standards and guidelines, and management prescriptions, as designed and implemented, are effective in meeting Forest Plan goals and objectives; and

Validation Monitoring is used to determine whether the data, assumptions, and coefficients used in the development of the Plan are correct.

Most monitoring elements involve the mitigation measures described previously. The mitigation measures are part of a process that includes these three types of monitoring to determine if the measure was implemented and is effective or needs revision. The feedback provided by monitoring results can be used to develop improved methods or additional treatments to ensure that the mitigation will be effective in the future. Figure 2-11 displays how this process of mitigation and monitoring occurs.

Figure 2-11
Mitigation/Monitoring Feedback Loop



Mitigation/Monitoring Feedback Loop

An annual monitoring report is prepared by each Administrative Area of the Tongass and incorporated into one report at the end of each year. This report addresses all monitoring questions contained in the applicable Forest Plan; references all monitoring being conducted on the Area/Forest; assesses progress toward achieving the goals and objectives described in the Forest Plan; and either certify that the Forest Plan is sufficient to guide management of the Forest over the next year or propose needed changes and an approach for dealing with those changes.

Forest Plan monitoring is conducted over the entire Forest on a sample basis. Samples may or may not be taken within the Upper Carroll Project Area; however, monitoring results are designed to answer questions regarding the implementation and effectiveness of mitigation within the Project Area. A total of 36 implementation, effectiveness, and validation monitoring items are identified in the forest-wide monitoring plan described in the TLMP RSDEIS (1996a). All monitoring is subject to funding and personnel limitations imposed upon the Agency.

Routine Implementation Monitoring

Routine implementation monitoring assesses whether the project was implemented as designed and whether or not it complies with the Forest Plan. Planning for routine implementation monitoring began with the preliminary design of harvest units and roads. Specialists used on-the-ground inventories, computer inventories, and aerial photographs to prepare the documents called unit cards for each harvest unit in each of the alternatives. Cards were also prepared for each segment of road. Resource specialists wrote their concerns on the cards and then described how the concerns could be addressed in the design of each unit and road segment. Resource concerns and mitigation measures will be refined further during final layout when specialists will have one more opportunity to revise the unit and road card recommendations. The unit and road card documents will be the basis for determining whether recommendations were implemented for various aspects of the Upper Carroll Project.

Routine implementation monitoring is part of the administration of a timber sale contract. The sale administrators and road inspectors ensure that the prescriptions contained on the unit and road cards are incorporated into contract documents and then monitor performance relative to contract requirements. Input by resource staff specialists; fisheries biologists, soil scientists, hydrologists and engineers, is regularly requested during this implementation monitoring process. These specialists provide technical advise when questions arise during project implementation.

The Ketchikan Area Forest staff annually conducts a review of Best Management Practice (BMP) implementation and effectiveness. The results of this monitoring are summarized in the Tongass National Forest Annual Monitoring and Evaluation Report, Fiscal Year 1995. This is the fourth annual Monitoring and Evaluation Report for the Tongass National Forest. The purpose of this report is to provide the public with information about how well the management direction of the Forest is being carried out and for measuring the accomplishments of anticipated outputs, activities, and effects.

Effectiveness Monitoring

Project-Specific Effectiveness Monitoring

In addition to the Forest Plan monitoring and routine implementation monitoring that will be conducted throughout the Tongass National Forest, including the Upper Carroll Project Area, project-specific effectiveness monitoring activities are identified. Effectiveness monitoring seeks answers about the effectiveness of design features or mitigation measures in protecting natural resources and their beneficial uses. Monitoring records will be kept by the responsible staff.

Sensitive Species

Choris Bog Orchid

Objective—To provide protection of specific habitats for this species which is located in the Upper Carroll Project Area.
Desired Result—Minimal site disturbance to populations of Choris Bog Orchid, particularly those located near harvest Units 20 and 49, and Carroll Creek.
Measurement—Protect known locations during sale implementation.
Threshold—Visual inspection of site indicates signs of disturbance or reduced vigor.
Corrective Action—Consult with Area TES coordinator.
Responsible Staff—Ketchikan Ranger District Staff timber/silviculture staff.
Record of Results—Daily diaries used for contract administration. Prepare a brief report of results each year.
Annual Cost—On-going business for timber/silviculture
FTE Needs—Zero

Trumpeter Swan

Objective—Protect wintering Trumpeter Swans.
Desired Results—Preferred swan wintering areas in Neets Bay and Carroll Inlet will be protected from disturbance.
Measurement—Visual observation of wintering swans at least once when any timber harvest or road construction occurs within one-half mile of Neets Bay or Carroll Creek estuaries between November 1 and April 1.
Threshold—Evidence that swans are avoiding available habitat because of forest management activities.
Corrective Action—Consult Ketchikan District Ranger and SO wildlife staff if a conflict arises.
Responsible Staff—Ketchikan Ranger District sale administration employees and wildlife staff.
Record of Results—Sale administrator may record swan observations in daily diary forms. Wildlife specialists will prepare a short memo.
Annual Cost—Ongoing business for sale administrator and wildlife specialist.
FTE Needs—Zero

Fisheries and Watershed

Stream Buffer Stability

Objective—To characterize the nature and effects of blowdown associated with Aquatic Habitat Management Unit (AHMU) Class I and II stream buffers and determine potential methods to minimize blowdown.

Desired Result—Determine the effectiveness of proposed AHMU Class I and II stream course protection prescriptions in meeting aquatic habitat management objectives. A refinement of future stream course protection prescriptions is anticipated.

Measurement—The percentage of blowdown basal area compared to the total stream buffer basal area. Randomly selected AHMU stream buffers will be sampled. The target sample size is stream buffers adjacent to two Upper Carroll timber harvest units. Conduct measurements every two years for a minimum of ten years.

Evaluation—The amount of blowdown in AHMU Class I and II stream buffers. Includes an assessment of the effects of blowdown upon aquatic habitat management objectives and the extent of these effects, both on-site and downstream.

Responsible Staff—Ketchikan Ranger District fisheries and watershed staffs.

Report of Results—Prepare a report.

Annual Costs—$10,500

FTE Needs—0.25 FTE

Temperature Sensitivity

Objective—To determine response of water temperature in potentially temperature sensitive hydrologic systems.

Desired Result—Attainment of State Water Quality Temperature Standards (WQS) for the growth and propagation of fish, shellfish, and other aquatic life and wildlife.

Measurement—State WQS criteria for temperature for fresh water uses. Criteria will be measured prior to, during, and following project implementation. Thermographs are currently in place at the outlets of sub-basins S4 and S5, and reach R5 in the Carroll Creek watershed to measure daily ranges in stream temperature. Further monitoring will be implemented near the units of concern (Chapter 3). Temperature data will be retrieved annually and the results documented.

Evaluation—Determine if selected streams meet criteria for State WQSs for fresh water uses. Determine if any deviation from WQSs can be correlated to Best Management Practices (BMP) implementation and forest management activities. Report and feedback results into validation monitoring needs and redesign of BMPs.

Responsible Staff—Ketchikan Ranger District fisheries staff.

Report of Results—Prepare a brief report.

Annual Costs—$3,500

FTE Needs—0.1 FTE

Neets Creek and Carroll Creek Stream Morphology

Objective—To provide baseline stream morphological data in conjunction with the watershed analysis to (1) quantify existing channel conditions and (2) provide a reference for post harvest monitoring for Neets Creek and Carroll Creek watersheds.

Desired Result—Cumulative effects assessment.

Measurement—Water temperature, stream cross-section, longitudinal profile, and the percent accumulation of fine sediments in stream gravels. Permanent reference cross-sections have been established in sub-basins S5, R4 and R5. Reaches will be re-measured periodically to evaluate changes in channel condition and fish habitat. The monitoring parameters are channel form, substrate size distribution, and key fish habitat indices such as pool and large woody debris data.

Evaluation—Determine if selected streams meet criteria for State WQSs for fresh water uses and Forest Service Alaska Region Fish Habitat Management Objectives (FHMOs). Determine if any deviation from existing conditions FHMOs can be correlated to BMP implementation and forest management activities. Report and feedback results into validation monitoring needs and redesign of BMPs.

Responsible Staff—Ketchikan Ranger District hydrology staff/Supervisor's Office watershed staff.

Report of Results—Prepare a brief report of results.

Annual Costs—$12,000.

FTE Needs—0.3 FTE

Transportation System

Road/Stream Crossing Condition Monitoring

Objective—Review of the Upper Carroll road system to evaluate the effectiveness of special design features, including bridges, culverts with fish passage requirements, slope stabilization structures and erosion control measures.

Desired Results—Identify effectiveness of construction practices in meeting water quality and aquatic habitat maintenance requirements. Identify where changes are needed to make the application of site-specific Best Management Practices (BMPs) more effective for water quality protection.

Measurement—Compliance with road design standards and on-site effects upon water quality (turbidity, sediment). Road condition surveys will be conducted 2, 5 and 7 years after the completion of activities in the Project area. The intent of the survey is to ensure that specified culverts are providing fish passage and to identify maintenance concerns.

Threshold—Visual inspection of site indicates signs of water quality degradation, obstructions to fish passage, occurrence of landslides, or significant amounts of erosion.

Corrective Action—When actions are required to protect water quality and aquatic habitat, design modifications are normally made during construction.

Responsible Staff—Ketchikan Ranger District fisheries/Supervisor's Office engineering staff.

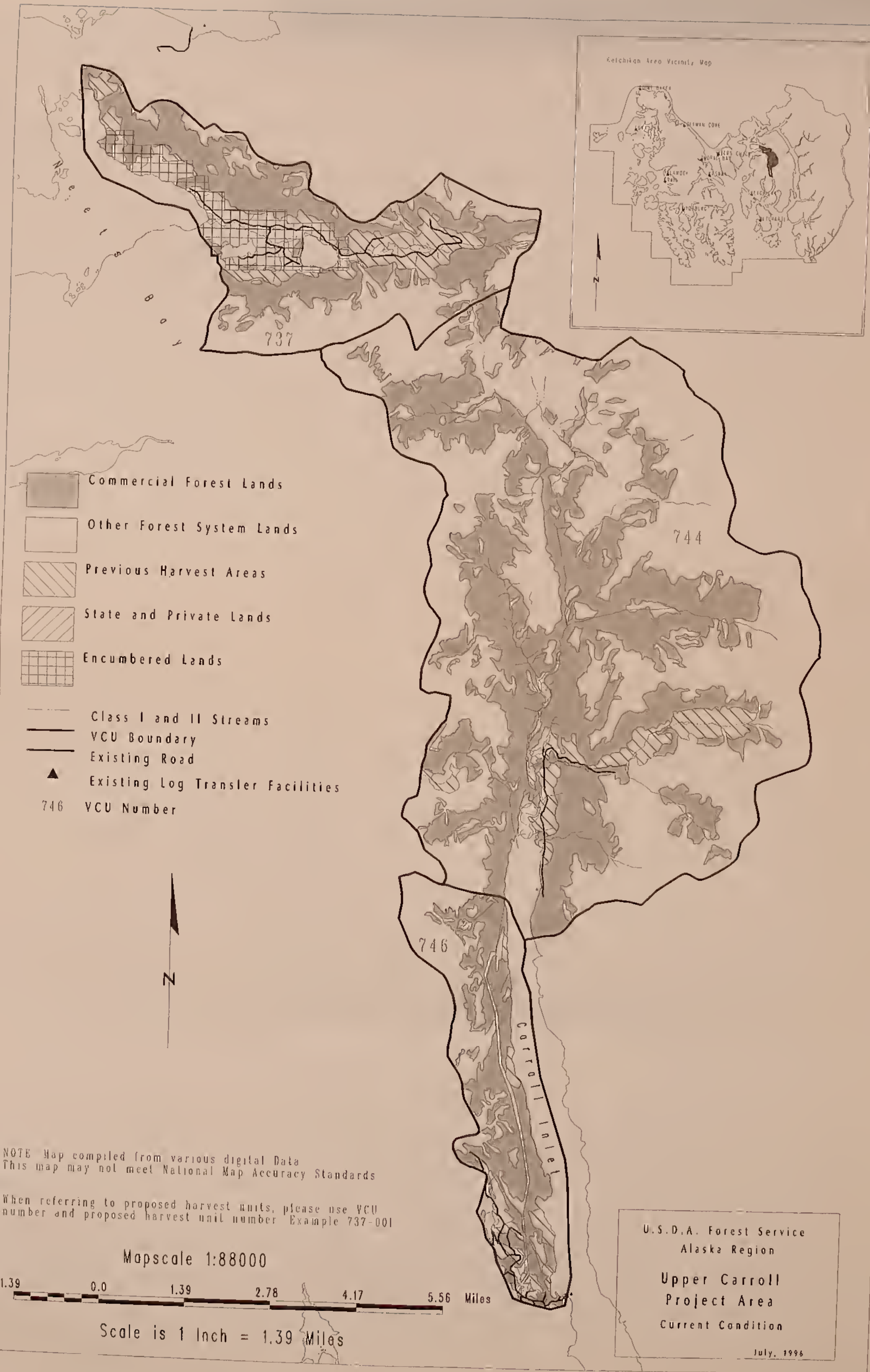
Record of Results—Road Condition Survey forms for each road segment in the Project Area. Prepare a brief report of results each year.

Annual Cost—$10,000

FTE Needs—0.25 FTE

Validation Monitoring

Validation monitoring is conducted to show if the assumptions or models used in planning are correct. It is usually carried out at the Regional level in conjunction with research. Validation monitoring may or may not occur within the Upper Carroll Project Area since this type of monitoring is built into a Forest-wide Action Plan.



Ketchikan Area Vicinity Map
737
744
746
Carroll Inlet
Neets Bay
Commercial Forest Lands
Other Forest System Lands
Previous Harvest Areas
State and Private Lands
Encumbered Lands
Class I and II Streams
VCU Boundary
Existing Road
Existing Log Transfer Facilities
746 VCU Number
N
NOTE Map compiled from various digital Data
This map may not meet National Map Accuracy Standards
When referring to proposed harvest units, please use VCU number and proposed harvest unit number Example 737-001
Mapscale 1:88000
1.39 0.0 1.39 2.78 4.17 5.56 Miles
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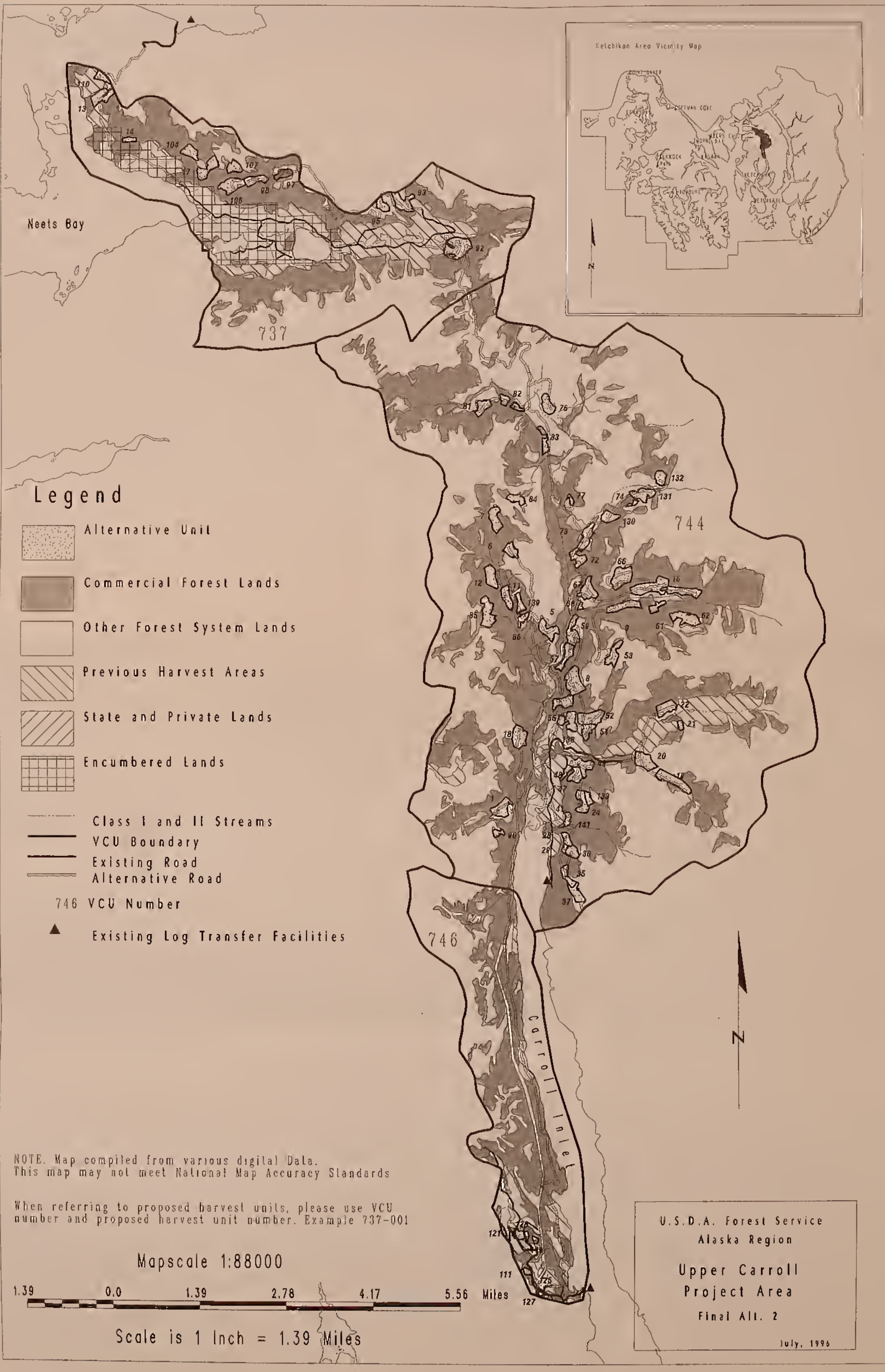
U.S.D.A. Forest Service
Alaska Region
Upper Carroll
Project Area
Current Condition
July, 1996



Ketchikan Area Vicinity Map
Neets Bay
737
744
746
Carroll Inlet
Legend
Alternative Unit
Commercial Forest Lands
Other Forest System Lands
Previous Harvest Areas
State and Private Lands
Encumbered Lands
Class I and II Streams
VCU Boundary
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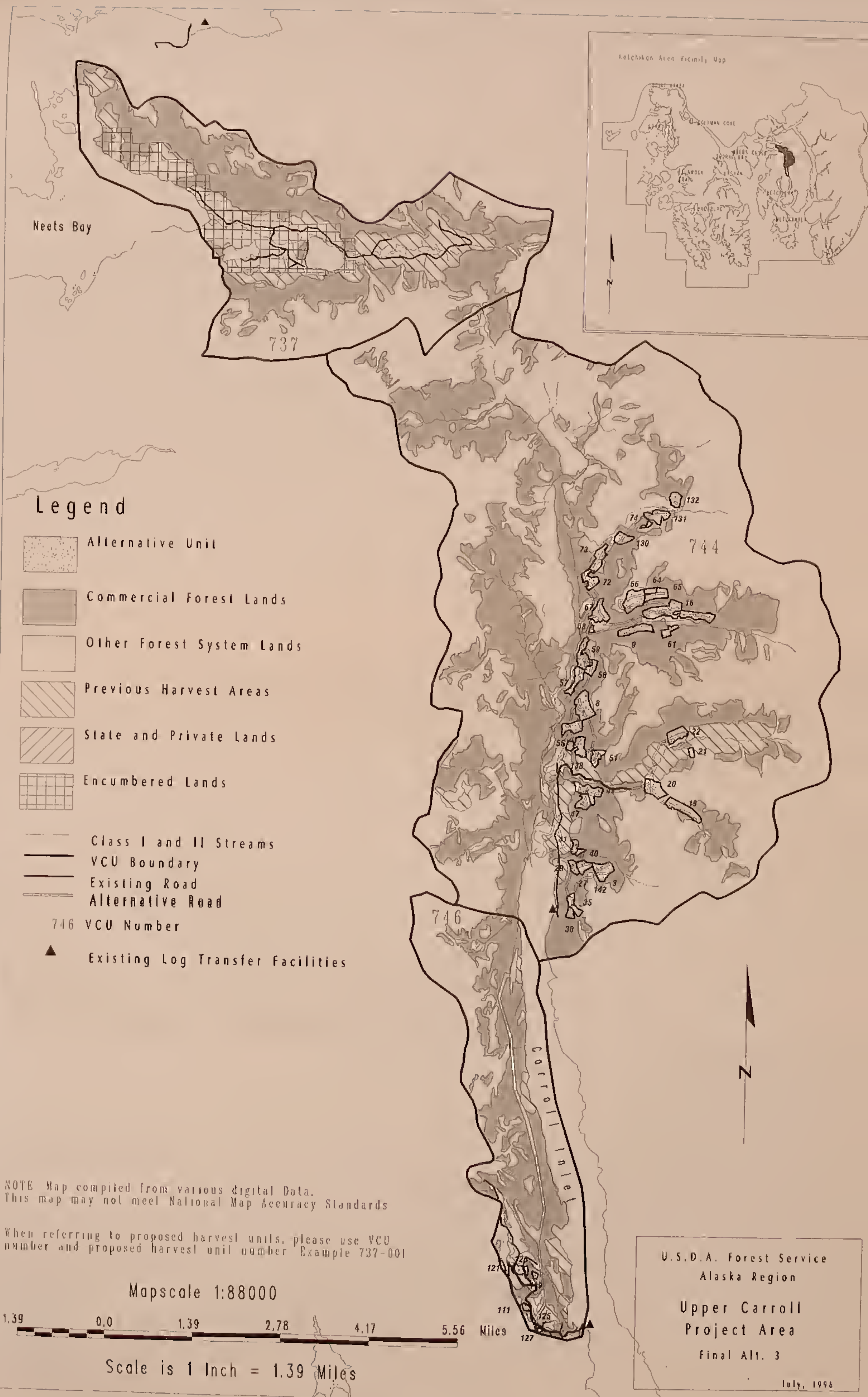
Alaska Region
Upper Carroll
Project Area
Final Alt. 2
July, 1996


Ketchikan Area Vicinity Map
Neets Bay
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Carroll Inlet
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Alternative Unit
Commercial Forest Lands
Other Forest System Lands
Previous Harvest Areas
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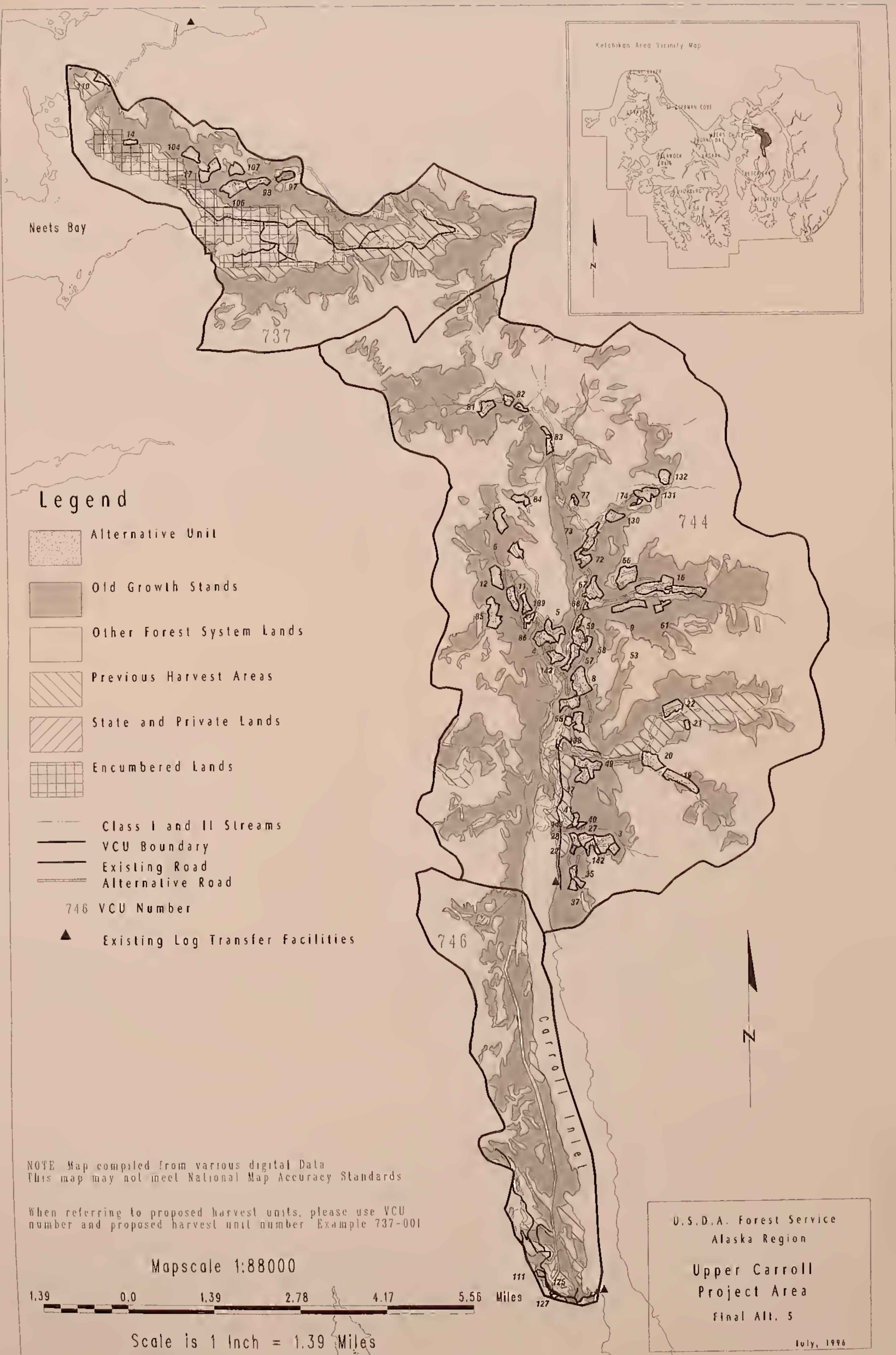
Scale is 1 Inch = 1.39 Miles
U.S.D.A. Forest Service
Alaska Region
Upper Carroll
Project Area
Final Alt. 3
July, 1998


Neets Bay
737
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Carroll Inlet
Ketchikan Area Vicinity Map
Legend
Alternative Unit
Old Growth Stands
Other Forest System Lands
Previous Harvest Areas
State and Private Lands
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VCU Boundary
Existing Road
Alternative Road
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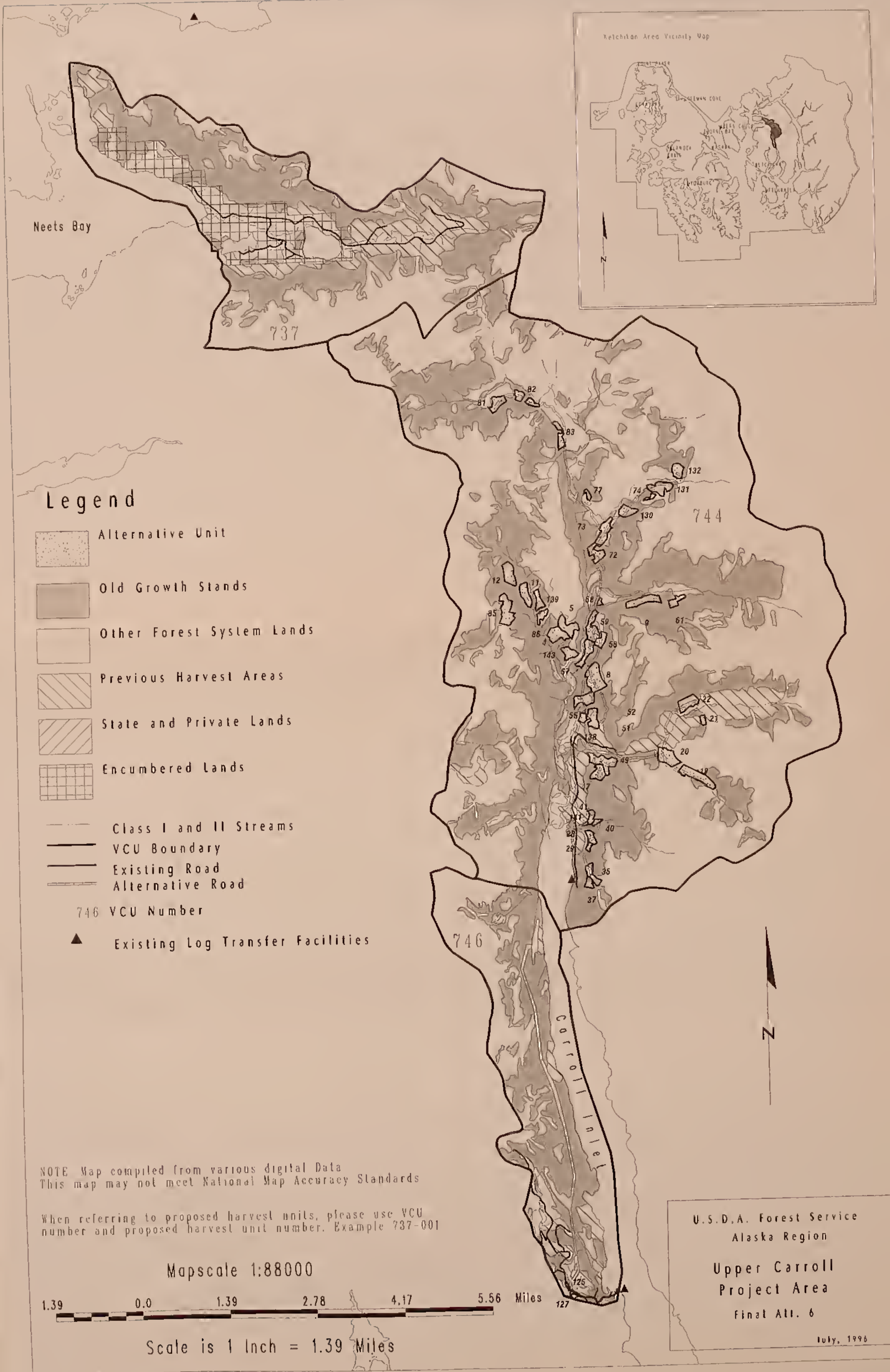
1.39 0.0 1.39 2.78 4.17 5.56 Miles
Scale is 1 Inch = 1.39 Miles
U.S.D.A. Forest Service
Alaska Region
Upper Carroll
Project Area
Final Alt. 5
July, 1996


Ketchikan Area Vicinity Map
Neets Bay
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Carroll Inlet
Legend
Alternative Unit
Old Growth Stands
Other Forest System Lands
Previous Harvest Areas
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Existing Road
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Scale is 1 Inch = 1.39 Miles
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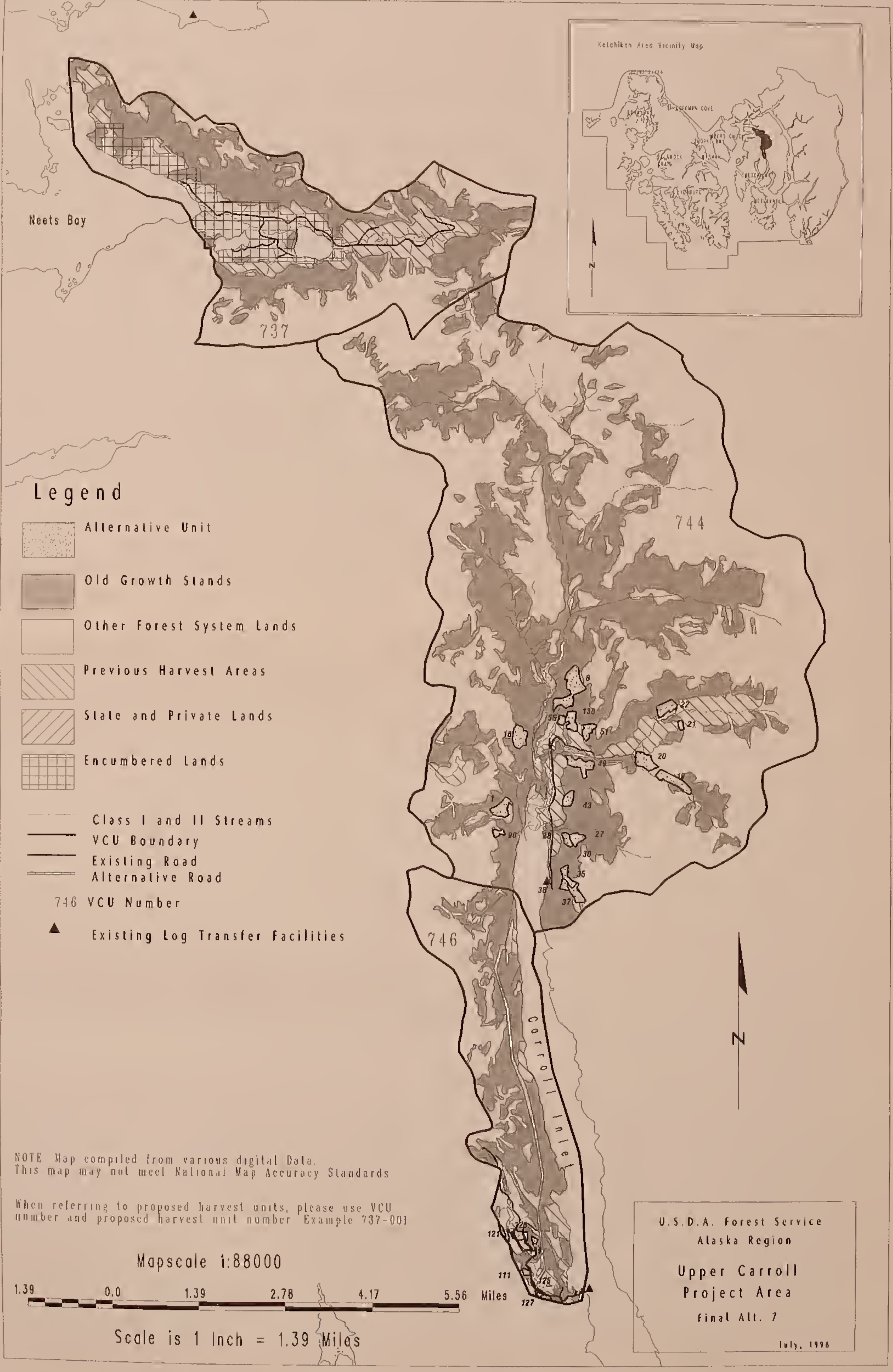
U.S.D.A. Forest Service
Alaska Region
Upper Carroll
Project Area
Final Alt. 6
July, 1996



Ketchikan Area Vicinity Map
Neets Bay
737
744
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Legend
Alternative Unit
Old Growth Stands
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1.39 0.0 1.39 2.78 4.17 5.56 Miles
Scale is 1 Inch = 1.39 Miles
U.S.D.A. Forest Service
Alaska Region
Upper Carroll
Project Area
Final Alt. 7
July, 1996

Chapter 3

Environment and Effects

Outline

Chapter 3

Affected Environment and Effects of the Alternatives

Introduction

This chapter presents information about those aspects of the environment that may be affected by the activities in the proposed alternatives. The "Affected Environment" portion of each resource section describes the current condition of the resource, trends related to its status, and relevant characteristics that may be subjected to impacts from the alternatives. The "Effects of the Alternatives" portion of each section presents the direct, indirect, and cumulative effects (or impacts) of activities under the alternatives. Thus, this chapter combines into a single chapter information that in many Environmental Impact Statements (EISs) appears in separate chapters (generally called Chapter 3 "Affected Environment" and Chapter 4 "Environmental Consequences"). This chapter provides the basis for the Comparison of the Alternatives section in Chapter 2.

Available Information

There is less than complete knowledge about many of the relationships and conditions of wildlife, fish, forests, jobs, and communities. The ecology, inventory, and management of a large forest area is a complex and developing science. The biology of wildlife species prompts questions about population dynamics and habitat relationships. The interaction of resource supply, the economy, and communities is the subject matter of an inexact science.

The interdisciplinary team (IDT) examined the data and relationships used to estimate the effects of the alternatives. The data and level of analysis used were commensurate with the importance of the possible impacts (40 CFR 1502.15); and relevant discussion in the TLMP (1979a, as amended) and the TLMP RSDEIS (1996a) is incorporated by reference (40 CFR 1502.21).

When encountering a gap in information, the IDT concluded that the missing information frequently would have added precision to estimates or better specified a relationship. However, the basic data and central relationships are sufficiently well established in the respective sciences that the new information would be very unlikely to reverse or nullify understood relationships. Thus, new information would be welcomed and would add precision, but it was not essential to a reasoned choice among the alternatives as they are constituted.

3 Environment and Effects

Analyzing Effects

Effects are quantified (where possible), although qualitative discussions may also be included. The means by which any identified potential adverse effects will be reduced or mitigated are described in detail in Chapter Two.

Environmental consequences are the effects of implementing an alternative on the physical, biological, social, and economic environment. *Direct* environmental effects are defined as those occurring at the same time and place as the initial cause or action. *Indirect* effects are those that occur later in time or are spatially removed from the activity but would be significant in the foreseeable future. *Cumulative* effects result from the incremental effects of actions when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

The reasonably foreseeable time frame over which both direct and indirect effects are estimated is until the end of the Ketchikan Pulp Company (KPC) Long-term Contract (the year 2004). This determination of reasonably foreseeable is based on the time frame of the KPC contract commitment. Alternative 2 is used to display the reasonably foreseeable future actions, because this is the maximum harvest alternative, within Forest Plan standards and guidelines, and volume not harvested in other action alternatives could be harvested as part of another project by the year 2004.

The cumulative effects are also projected for various resources up to the year 2054 and 2140. The year 2054 is the year by which most areas within land use designations (LUDs) permitting timber harvest will be converted from old-growth to second-growth timber management. The year 2140 is when the Forest Plan estimates the management emphasis or desired future condition will be reached. The cumulative effects analysis in this document tiers to the current Tongass Land Management Plan (TLMP (1979a, as amended). It also considers the 10-year timber sale action plan referenced in Appendix A which is used to project the volume range to be harvested in each operating period through the end of the Ketchikan Pulp Company (KPC) contract. As a result, the cumulative effects do not depend entirely on the alternatives presented in this EIS. Rather, they include what may be expected under the direction detailed in TLMP. The decisions made in Forest Plan provide long-range direction for management of the Tongass National Forest for the duration of the Forest Plan. Cumulative effects analyzed in this EIS include both the effects of this project and those projected by the TLMP (1979a, as amended) and the TLMP RSDEIS (1996a), Preferred Alternative, which are hereby incorporated by reference.

The following assumptions were made to assess the reasonably foreseeable effects to the year 2004. These assumptions reflect current management and technology of national forests and provide a uniform approach to estimating effects of timber harvest and road construction.

- Laws, standards, guidelines, and Best Management Practices (BMPs) for water quality would be followed. These requirements are expected to be at least as stringent in the future as they are today.

- Timber sale planning would use an interdisciplinary process.

- All acres of suitable land, as identified in the Preferred Alternative of the TLMP RSDEIS (1996a), would be equally subject to impacts.

- The no-action alternative would represent only a delay in implementing the TLMP and, based on volume projections in the ten year timber sale action plan, foreseeable cumulative effects would begin to occur before 2004.

- Future effects on resources from timber harvest and road construction would be similar to impacts projected for current alternatives.

Potential adverse environmental effects which cannot be avoided are discussed. Unavoidable adverse effects may result from managing the land for one resource at the expense of the use or condition of other resources. Many adverse effects can be reduced or mitigated by limiting the extent or duration of effects. Mitigation measures within standards and guidelines are specified for project activities to be implemented under the alternatives. These are discussed briefly throughout the chapter, and in detail in Chapter Two.

- *Short-term effects* are those that occur annually or within the first 10 years of project implementation.

- *Long-term productivity* refers to the capability of the land and resources to continue producing goods and services for 50 years and beyond.

- *Irreversible commitments* are decisions affecting non-renewable resources such as soils, minerals, plant and animal species, and cultural resources. Such commitments of resources are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense, or the resource has been destroyed or removed. For example, a rock pit which is used to provide rock to build roads throughout the Project Area would be considered an irreversible commitment of the resource. Land-use designations (LUDs) allowing land-altering activities were established by the Forest Plan, but the actual commitment to develop, use, or affect non-renewable resources in the Upper Carroll Project Area was made during the development of this project.

- *Irretrievable commitments* represent opportunities foregone for the period during which resource use or production cannot be realized. These decisions are reversible, but the production opportunities foregone are irretrievable. An example of such commitments is the allocation of LUDs that do not allow timber harvest in areas containing suitable and accessible timber lands, a decision that is made at the Forest Plan level. For the time over which such allocations are made, the opportunity to produce timber from those areas is foregone, thus irretrievable. Irreversible and irretrievable commitments resulting from this project are discussed in more detail at the end of this chapter.

Land Divisions

The land area of the Tongass National Forest has been divided in several different ways to describe the different resources and allow analysis of how they may be affected by Forest Plan and project level decisions. These divisions vary by resource since the relationship of each resource to geographic conditions and zones also varies. Four of these are used for more than one resource and are described briefly here.

Ecological Provinces

The Tongass National Forest identifies 21 large land areas that are distinguished by differences in ecological processes (TLMP RSDEIS (1996a), Chapter 3, Biodiversity). They are defined by a combination of climatic and geographic features. The Upper Carroll Project Area lies within the Revilla Island/Cleveland Peninsula ecological province (Number 15) and is discussed in the Biological Diversity and Wildlife sections of this chapter.

3 Environment and Effects

Management Areas

The 1979 Forest Plan (USDA Forest Service 1979a, as amended) divided the Tongass into 141 management areas, two of which are in the Upper Carroll Project Area. Each management area has area-specific direction and activity schedules. The Tongass Timber Reform Act directed that "proportionality" (see Chapter One, and the Timber section of this chapter) be analyzed using the management areas. The 141 areas are, therefore, preserved in this analysis and are used to ensure that the proportionality requirement is met. (See TLMP Draft Revision, Proposed Revised Forest Plan, Chapter 5, for a detailed analysis.) Management Areas K32 and K35 are within the Upper Carroll Project Area.

Value Comparison Units (VCUs)

These are distinct geographic areas, each encompassing a drainage basin containing one or more large stream systems. The boundaries usually follow major watershed divides. The Tongass contains 867 VCUs; three are found in the Upper Carroll Project Area. They are used to describe the locations of specific resources in the Project Area. VCUs 737, 744, and 746 are within the Upper Carroll Project Area.

Wildlife Analysis Areas (WAAs)

These are Forest Service land divisions that correspond to Minor Harvest Areas used by the Alaska Department of Fish and Game. Approximately 190 apply to the Tongass National Forest, two of which apply to the Upper Carroll Project Area. They are used in the Subsistence and Wildlife sections. Portions of WAAs 406 and 510 are included within the Upper Carroll project Area.

Geographic Information System

The Tongass National Forest has developed a computerized geographic information system (GIS) which was used for the development of this project. The GIS is a large data base, containing information on many of the resources of the Forest. Much of the data consists of layers, each representing a particular resource or attribute (such as vegetative species, soil types, or recreation places). This system makes it possible to do spatial analysis of alternatives and effects and to rapidly display resource information in map (plot) format. Numerical data can also be stored, displayed, and analyzed.

Description of the Ecosystem

Project Area

The Upper Carroll Project Area lies within the Revillagigedo (Revilla) Island/Cleveland Peninsula ecological province. This province includes Revillagigedo, Annette, Duke, and Gravina Islands and the Cleveland Peninsula south and west of Eagle Lake. This province is a combination of climatic and geographic features. The Revilla Island/Cleveland Peninsula Ecological Province includes 1,174,490 acres, of which 47,942 acres (including 2,381 acres of saltwater) are within the Upper Carroll Project Area. This province contains 526,226 acres of productive old growth and approximately six percent of the available old growth has been harvested since 1954 (TLMP RSDEIS (1996a).

The Cleveland Peninsula portion of the province is a part of the mainland of Southeast Alaska's panhandle region. The remainder of the ecological province is made up of Revillagigedo Island.

The Project Area is mountainous, often rising abruptly from sea level to several thousand feet. Elevations of forested areas extend up to approximately 2,200 feet in the Project Area.

Abiotic Components

The configuration of the coastline, the warm Japanese ocean current, and the high coastal mountains produce abundant rainfall. Storms and moderate to heavy precipitation occur year round, but most commonly from September through November. The abundant moisture feeds numerous streams, rivers, and lakes.

The Upper Carroll Project Area has a maritime climate, resulting from the moderating influence of the Pacific Ocean. In the summer, this provides a cooling influence, while in winter, temperatures are warmer than would be expected for these latitudes. Normal temperatures range from the mid-40s to the mid-60s in the summer, and from the high teens to the low-40s in the winter. During the warmer months, temperatures are highest inland and lowest along the coasts, while in the colder months, the reverse is true.

The Upper Carroll Project Area has complete cloud cover about 85 percent of the year. October is generally the wettest month. High precipitation persists through the middle of November when intermittent snowfall occurs. Snowfall varies according to elevation and distance inland from the coast. Snow accumulation below 500 feet elevation is short-lived, generally melting off within a few days due to warmer temperatures and rain.

The local climate has had a significant influence upon the landscape ecology of Revilla Island. Moderate temperatures and ample precipitation produce good growing conditions for commercial forest species. Relatively low annual temperatures and abundant moisture produce slow rates of decomposition, resulting in the characteristic buildup of organic matter over much of the areas landscape. Storms producing strong winds in excess of 80 knots and heavy precipitation may be expected during the fall season, September through December. The winds generated by these storms are significant factors in the development of forest stands. Blowdown events ranging from a few trees to several hundred acres may occur. These windthrow events, accompanied by heavy precipitation and saturation of the soil, may be a significant trigger for landslides in forested areas. Windthrow events are further discussed in the Silviculture section of Chapter 3.

The long-term climatic reporting station at Bell Island, just to the north of the Project Area, reported annual observations from 1929-1952. Table Introduction-1 shows mean bi-monthly temperatures and precipitation from the Bell Island recording station.

Table Introduction-1
Bell Island Observations (1929-1952)

	Fahrenheit Temperature	Precipitation in inches
January	29.5	11.17
March	34.6	8.12
May	48.7	4.94
July	58.6	5.47
September	53.0	11.35
November	36.5	13.49
Annual Average	**43.7**	**108.67**

SOURCE: Nightingale 1996

Biotic Components

The coastal forest of the Revilla Island/Cleveland Peninsula Ecological Province is part of the cool, temperate rainforest that extends along the Pacific coast from southern British Columbia to Prince William Sound. Most of the forest is composed of old-growth conifers, primarily western hemlock and Sitka spruce, with mountain hemlock, western redcedar and Alaska yellowcedar as other major components. Red alder is common along streams, beach fringes, and on sites recently disturbed by logging and landslides. Subalpine fir occurs occasionally at tree line.

Blueberries, huckleberry, Sitka alder, devil's club, and salal are common shrubs in the forest. Plant growth on the forest floor includes deerheart, dwarf dogwood, single delight, and skunk cabbage. Mosses grow in great profusion on the ground, on fallen logs, on the lower branches of trees, and in forest openings.

Grass-sedge meadows usually are located along lakes and major streams. Interspersed throughout the forest are muskegs, supporting plant communities dominated by sphagnum mosses and sedges.

The alpine zone usually lies above 2,500 feet. It occupies the area above the coastal forest and is separated from the forest by a subalpine or transition zone. Alpine plants have adapted to snowpack and wind abrasion by evolving low-profile growth forms. Low, mat-forming vegetation covers most alpine areas, with cushion-like plants occupying crevices on rock outcrops and talus slopes.

The forests, shorelines, streams, and rivers of Southeast Alaska provide habitat for over 350 species of birds and mammals, including both nongame animals and animals such as black bear, Sitka black-tailed deer, moose, wolf, mountain goat, beaver, otter and marten. Many of these are found in the Project Area. The coastline provides an ideal habitat for a large population of bald eagles, and wetlands provide nesting habitat for waterfowl.

A highly productive marine environment includes an abundance of marine mammals, halibut, herring, and shellfish. Both resident and anadromous fish are found within and adjacent to the Project Area, including five species of Pacific salmon, Dolly Varden char, cutthroat trout, and steelhead trout.

Site-specific information on biological resources in the Project Area follows in various sections of this chapter.

Air Quality

Key Terms

Ambient Air—that air, external to building, encompassing or surrounding a specific region.
Ambient Air Quality Standard—the prescribed level of pollutants in the outside air that cannot be exceeded legally during a specified time in a specified geographical area.
Class I Airshed—one of three classes of areas provided for in the Clean Air Act for the Prevention of Significant Deterioration program. Class I airsheds are the "cleanest" and receive special visibility protection.
Class II Airshed—the second of three classes of areas provided for in the Clean Air Act. Class II Airsheds have no specific attainment criteria.
PSD—Prevention of Significant Deterioration of ambient air quality is a program established by the Clean Air Act to protect air quality and air-quality-related values.

Affected Environment

Although there is little scientific information on the baseline air quality of the Upper Carroll Project Area, the air quality of the region is generally good. Exchange of air typically comes from relatively pollution-free air off the Gulf of Alaska. Local sources of airborne particulates include motor vehicle emissions, motor vessels and cruise ships, dust, residential and commercial heating sources in the Ketchikan Gateway Borough population center, marine traffic on Tongass Narrows, the Ketchikan Pulp Company mill at Ward Cove, and a limited amount of prescribed burning.

Vehicles and home heating, particularly wood-fired heating, contribute to regional particulate matter concentrations. Alaska has experienced localized problems with wood smoke and has issued regulations that limit open burning and other air pollution-generating activities in wood smoke control areas between November 1 and March 31. The wood smoke control areas do not include the Upper Carroll Project Area. Open burning may be restricted in the Project Area when an air quality advisory is issued by the Alaska Department of Environmental Conservation (ADEC) (AAC 50.030). The ADEC has the primary responsibility for attainment and maintenance of Ambient Air Quality Standards under the provisions of the Clean Air Act (see Revised TLMP Draft Revision for related air quality discussion). The Forest Service cooperates with the Alaska agency to protect air quality in National Forests. The entire Project Area is a Class II airshed for purposes of Prevention of Significant Deterioration and does not have specific attainment criteria under the Clean Air Act. There are no Class I airsheds designated in Southeast Alaska which is a more restrictive requirement.

Effects of the Alternatives

Direct, Indirect and Cumulative Effects

There is presently little information on the possible effects of ambient air quality on forest resources in Southeast Alaska. Forest health monitoring recently initiated under a national resource program includes air resource related parameters. Methods of conducting inventories are being developed to address this information need. Monitoring of baseline resource conditions on the forest is being conducted at this time.

National Ambient Air Quality Standards (NAAQS) for indicators of matter less than ten microns (PM_{10}) in size are established by Federal Environmental Protection Agendy (EPA) as the concentration limits needed to protect all of the public against adverse effects on public health and welfare. PM_{10} indicators are utilized because the human respiratory system cannot efficiently filter out particulate matter this size or smaller. Wildfires and prescribed fires can be a source of fugitive particulate matter less than ten microns in size.

Prevention of Significant Deterioration (PSD) of ambient air quality is a program established by the Clean Air Act to:

a. Protect public health and welfare from any actual or potential adverse effects from air pollutants not withstanding attainment and maintenance of all national ambient air quality standards.

b. Ensure economic growth will occur in a manner consistent with the preservation of existing clean air resources.

c. Preserve air quality and air quality related values in areas of special national or regional natural, recreational, scenic, or historic values.

d. Ensure that any decision to permit increased air pollution is made only after there has been adequate opportunity for informed public participation in the decision making process and after careful evaluation of all consequences.

The NAAQS for particulate matter less than ten microns in size would not be violated by the proposed action. PSD increments in the Southeast Alaska Intrastate Air Quality Control Region, for sulphur dioxide, oxides of nitrogen, and total suspended particulate, have not at this point in time been triggered, making an analysis unnecessary.

All of the management alternatives are expected to have limited, short-term impact on the ambient air-quality. Alternative 1, the No-Action Alternative, would result in the least emission of particulate and gaseous air pollutants in the near term. The potential for uncontrolled forest fires would be slightly higher for the action alternatives because of the logging slash created. The occurrence of forest fires, even when logging slash is present, is extremely rare in Southeast Alaska due to the amount of precipitation received throughout the year.

Effects on Air Quality Outside the Project Area

The action alternatives may result in a continued supply of raw wood products to the Ketchikan Pulp Company (KPC) mill at Ketchikan. This would indirectly affect air quality at the KPC's mill at Ward Cove, Alaska. Processing of timber harvested from the Upper Carroll Area would result in emissions into the air and may affect air quality.

KPC operates a dissolving sulfite pulp mill in Ward Cove near Ketchikan, Alaska. As part of a request by the Alaska Department of Environmental Conservation (ADEC) and as part of KPC's most recent air quality permit to operate, KPC submitted a dispersion modeling assessment to address the ambient impacts of various mill emissions. The results of the dispersion modeling analysis indicated that, under specific mill operating conditions, the facility emissions had the potential to exceed the Alaska Ambient Air Quality Standard (AAAQS) for fine particulate matter (PM_{10}) and sulfur dioxide (SO_2) as defined in Chapter 18 of the Alaska Administrative Code, Section 50.010 (18 AAC 50.010). Based on this assessment, KPC and the ADEC entered into a consent decree in which KPC agreed to perform an ambient impact assessment for PM_{10} , carbon monoxide (CO), total reduced sulfur (TRS), SO_2, nitrogen dioxide (NO_2), lead (Pb_2), and chloroform emissions from the facility.

By the consent decree, KPC also agreed to conduct ambient air quality monitoring for SO_2 and PM_{10} at a minimum of two locations near the mill if required as a result of the ambient impact assessment. The ambient impact assessment is also an important component for siting the ambient monitors, if necessary, for an air quality network.

KPC retained EMCON and Industra (a process engineering firm for the pulp and paper industry, located in Portland, Oregon) to prepare the protocol to be used in the ambient impact assessment, gather the necessary emission data, and conduct the ambient impact analysis.

The evaluation of the potential impacts of KPC's activities upon air quality at Ward Cove is the responsibility of the EPA and the ADEC and are fully disclosed in a separate study. The *Revised Ambient Impact Assessment Protocol, Ketchikan Pulp Company, Ketchikan, Alaska* was prepared, approved, and submitted to the ADEC on August 29, 1995. The *Impact Assessment Protocol* outlines the approach used in conducting various air quality impact evaluations. Included are sections that describe, (1) the emission sources of interest, (2) the operating scenarios and related emission rates, (3) the modeling methodology used, and (4) the results of the modeling analysis. As such, an analysis of these effects in the Upper Carroll FEIS would be redundant and outside the scope of the Project.

KPC has proposed to extend one of its existing National Pollutant Discharge Elimination System (NPDES) permitted wastewater outfalls from Ward Cove to a new location in the Tongass Narrows. KPC has prepared a number of documents to support its request for an NPDES permit for the extended outfall, including "Outfall Extension Study", April, 1994; "Mixing Zone Request and Environmental Analysis for Outfall Extension into Tongass Narrows - Revised", August, 1994; and "Alaska Department of Environmental Conservation (ADEC) Information Request Work Plan", February, 1995. The latest of these studies, the ADEC Information Request Work Plan is a tiered risk assessment using an initial "screening level" assessment of the potential incremental risks to the environment and human health that might result from exposure to discharges from an extended outfall.

For further information on the effect of KPC's operations on air quality at Ward Cove and EPA's permitting process, contact the EPA Region 10 Office in Seattle, Washington, or the Alaska Department of Environmental Conservation offices in Ketchikan or Juneau, Alaska.

Water Resources

Key Terms

Bedload—sand, silt and gravel, or soil and rock debris rolled along the bottom of a stream by moving water.
Best Management Practices (BMPs)—land management methods, measures, or practices intended to minimize or reduce water pollution.
Biotic—living.
Mitigation—measures designed to counteract environmental impacts or to make impacts less severe.
Sediment—water-transported earth materials.
Stream flow regime—the characteristic discharge of water from a watershed that occurs in the natural stream channel.
Solute—substance dissolved in a solution.
Turbidity—an indicator of the amount of sediment suspended in water.
V-notch—a deeply incised, narrow valley along a drainage with a characteristic "V" shaped cross-section.

Affected Environment

The Upper Carroll Project Area is characterized by an abundance of water. These water resources can be broken into three areas of consideration. These include: (1) consumptive water use; (2) stream flow regime; and (3) water quality, including sediment, water temperature, and water chemistry. All of these are influenced by climate which is discussed in the Introduction to Chapter 3. Additional information about watersheds and fish habitats are discussed in the Fisheries section of this chapter.

Consumptive Water Use

The only known continuous consumptive water use within the Project Area is Southern Southeast Regional Aquaculture Association (SSRAA) Neets Bay Fish Hatchery which utilizes surface water from the Neets Creek and lake system for domestic water supply, power generation, fish propagation, and enhancement. A logging camp operated by Ketchikan Pulp Company (KPC) at Shelter Cove utilizes surface water for domestic water supply on a seasonal basis.

There are no congressionally designated municipal watersheds within the Project Area.

Stream Flow Water Quality

The physical and chemical properties of water can directly affect water uses by people and other living organisms. Carroll Creek and Neets Creek are systems which require maintenance or improvement of water quality to protect beneficial uses. The most important characteristics for water management on the Project Area are temperature, sediment, and chemical properties, especially dissolved oxygen and foreign chemicals. These water quality characteristics are discussed below and correspond to the key water quality parameters identified in the State of Alaska water quality criteria for maintaining natural productivity of aquatic organisms.

Temperature
Water temperature is a principle regulator of biological activities in the aquatic environment. The metabolic activity of fish, and most other aquatic organisms, is controlled by water temperature. This activity proceeds most efficiently within a limited temperature range. According to State of Alaska Water Quality Standards for the growth and propagation of fish and other aquatic life, water temperature shall not exceed 65 degrees Fahrenheit (F) at any time, and the maximum temperature shall not exceed 58 degrees F for fish migration and rearing, and 56 degrees F for spawning, egg, and fry stages.

The principle source of heat for small streams is solar energy striking the stream surface. Streams in the Project Area are not highly sensitive to temperature changes. Frequent cloud cover, low air temperatures, steep channel gradients, abundant precipitation, and snow melt runoff through most of the summer keep stream temperatures below the range considered harmful to aquatic organisms.

Sediment
Water-transported earth materials are called sediment. Sediment in streams may be transported as either suspended or bedload sediment. Suspended sediment is carried within the water column, while bedload material moves (rolls or bounces) along the bottom of the stream or riverbed. Suspended sediment causes water to appear murky or turbid. Under natural conditions both suspended and bedload sediments move during storm runoff events. The rate of sediment transport depends on discharge velocity and availability of materials. Natural suspended sediment concentrations in watersheds in Southeast Alaska are typically low (Paustian 1987).

Stream sediment originates from both geologic and human activities. There are examples of both within the Carroll Creek and Neets Creek watersheds. The main natural processes creating sediment are landslides and streambank/channel erosion. Recent landslides in the Bluff Lake area have introduced sediment into the Neets Creek system. A regional study (Swanston 1989) indicates that about 3 percent of all major landslides directly affect fish-bearing streams. Active streambank erosion is obvious on several of the eastern tributaries of Carroll Creek. A high (at least 150 feet) sand bank along the first major eastern tributary of Carroll Creek is a significant natural source of sediment. The second major eastern tributary contains an actively eroding V-notch which has recently produced a large amount of sediment.

The major sources of management induced sediment in the area result from: (1) road construction activities, (2) road use and maintenance, and (3) logging activities. Another source of sediment is construction, maintenance, and water diversion activities associated with the SSRAA hatchery at Neets Bay.

Water Chemistry
Dissolved oxygen is typically at or near saturation in fast-running streams in the Project Area because the churning action tends to bring oxygen into the water. Streams in the area typically are slightly acid. Although water in Southeast Alaska is never completely free of organic and inorganic matter, chemical water quality is high. Concentrations of total dissolved solids are typically less than 150 parts per million (ppm).

Historic introductions of foreign chemicals, such as motor oil, fertilizers, and other petroleum products into surface waters of the area have been very low.

Beneficial Uses
The waters of the area are an important source of habitat for resident and anadromous fish (see *Carroll Creek Resource Report*), and other aquatic life. The SSRAA utilizes water for a fish hatchery and associated residential uses on Bluff Lake and Neets Creek. Additional beneficial uses of the waters of the study area include channel maintenance, dispersed recreation use (see *Upper Carroll Recreation Resource Report*), terrestrial wildlife habitat (see *Upper Carroll Wildlife Resource Report*), and subsistence harvest.

Streams
The major stream systems within the Upper Carroll Project Area are the Carroll Creek and Neets Creek. Both are located in the north-central part of Revillagigedo (Revilla) Island in southeast Alaska. Both are relatively short stream systems, Carroll Creek being about nine miles long and the Neets Creek system about five miles long. Carroll Creek flows mainly in a north-south direction from the interior of Revillagigedo Island and empties into the tidal waters of Carroll Inlet about 20 miles north-northeast of Ketchikan, Alaska. Neets Creek flows westward and drains into Neets Bay about 24 miles north of Ketchikan.

The Alaska Region Channel Type Classification System (see Channel Type User Guide) was developed with water resource management needs in mind. Individual channel type classification units are defined by physical attributes, such as channel gradient, channel pattern, stream bank incision and containment, and riparian plant community composition. Channel types are a means of distinguishing the various parts of a stream system. They allow us to define the characteristics of the channel and to predict, with a high degree of accuracy, probable responses to natural and human influences. Channel types help define the parts of a drainage basin and, as such, are tools intended to complement a holistic watershed management approach.

The Upper Carroll Project Area contains a range of channel types, mostly in the Palustrine, Floodplain, Large Contained, Moderate Gradient Mixed Control, Moderate Gradient Contained, and High Gradient Contained Process Groups. A small amount of the Estuarine and Alluvial Fan Process Groups are also included.

The amount of channel type by Process Group and Channel Type within the Project Area are:

Process Group	Channel Type	Miles of Channel
Estuarine	ES4 Large Estuarine Channel	4.8
Palustrine	PA1 Narrow Placid Flow Channel	3.7
Flood Plain	FP3 Narrow Low Gradient Flood Plain	5.8
	FP4 Low Gradient Flood Plain Channel	5.2
	FP5 Wide Low Gradient Flood Plain	6.4
Alluvial Fan	AF1 Moderate Gradient Alluvial Fan	2.6
	AF2 High Gradient Alluvial Fan	6.3
Large Contained	LC1 Low Gradient Contained Channel	0.9
	LC2 Moderate Gradient Contained Narrow Valley Channel	0.8
Moderate Gradient Mixed Control	MM1 Narrow Mixed Control Channel	6.6
	MM2 Moderate Width Mixed Control Channel	8.3
Moderate Gradient Contained	MC1 Narrow Shallow Contained Channel	2.0
	MC2 Moderate Width and Incision, Contained Channel	6.0
	MC3 Deeply Incised Contained Channel	2.3
High Gradient Contained	HC1 Shallowly Incised Muskeg Channel	5.7
	HC2 Shallow to Moderately Incised Footslope Channel	6.5
	HC3 Deeply Incised Upper Valley Channel	11.7
	HC4 Deeply Incised Muskeg Channel	8.0
	HC5 Shallowly Incised Very High Gradient Channel	51.9
	HC6 Deeply Incised Mountainslope Channel	80.3

All streams in the Project Area produce a large volume of runoff per unit of land in the watershed. Runoff varies greatly, depending upon the time of year. Spring snowmelt contributes to increased runoff between April and June. In some streams, spring runoff can often approach fall runoff levels, which generally is the period of highest stream flows. Two relatively low flow periods are characteristic of these systems: the first occurs between January and March during periods of snow accumulation and low temperatures, and the second is during mid-July to August, a period of relatively low precipitation.

Lakes

Small lakes are scattered throughout the Upper Carroll Project Area. Only two named lakes are located within the Project Area, Neets Lake and Bluff Lake in the Neets Creek valley. There is a total of about 367 surface acres of lakes and ponds within the area.

Watersheds

Carroll Creek and its tributaries drain most of the Upper Carroll Study area. The headwaters of Carroll Creek originate in the north part of the study area and flow southward, entering saltwater at the head of Carroll Inlet. Several small tributary streams enter Carroll Creek from the east, draining the western flanks of Mount Reid and its associated summits. The Carroll Creek drainage contains a number of small, unnamed lakes, mostly on the west side of the valley. The Carroll Creek drains a watershed of about 32,000 acres. Also included in the Upper Carroll Project Area is the Neets Creek drainage. Neets Creek headwaters are just to the north of the headwaters of Carroll Creek across a low divide. Neets Creek drains to the west, flowing through a broad valley before entering saltwater at the head of Neets Bay. The Neets Creek system includes two lakes, Neets and Bluff, in its middle to lower reaches. The Neets Creek watershed covers about 9,000 acres. The Carroll Creek system is included in National Forest System (NFS) Watershed Number 1901010207K. Neets Creek is located in NFS Watershed Number 1901010210K.

The dominant topographic feature in these watersheds is the mountain ridge, the highest on Revillagigedo Island, which borders the east side of the Carroll Creek valley. Generally the topography of these watersheds is typical of that of Pleistocene glaciated valleys in the Alexander Archipelago. The Carroll Creek and Neets Creek valleys have the typical U-shape with broad, relatively flat bottoms, and steep sideslopes which are topped by broad, rounded mountain ridges. Hanging side valleys which contain cirque lakes or steep gradient mountain tributaries with numerous falls are common. Elevations range from sea level to 4,592 feet on the summit of Mount Reid, although most mountain ridges in the area average about 2,600 to 3,000 feet high.

Precipitation

Surface water in the Upper Carroll Project Area has its origin in the abundant precipitation that is characteristic of the temperate maritime climate of Southeast Alaska. Estimated mean annual precipitation in the area ranges from less than 120 inches at sea level at the head of Neets Bay to over 200 inches on the summit of Mount Reid at an elevation of over 4,500 feet. Much of the precipitation at higher elevations is received as snow. As a result of abundant snowpack, which may persist at higher elevations into late summer, particularly on the mountain ridges which form the western edge of the study area, snowmelt runoff is an important contribution to flows in Carroll Creek, particularly during lowflow periods in mid-to-late summer. No known areas of perennial snow and ice are located within the area.

Groundwater

Little is known about the characteristics of groundwater hydrology in the mountain valleys of Southeast Alaska. Extensive areas of poorly to very-poorly drained peatlands in the Carroll Creek valley serve as areas which intercept, store, and discharge runoff. Unconsolidated glacial drift, outwash, colluvium and residual material, and to an unknown degree local bedrock, serve as mediums for groundwater flow, as evidenced by the numerous springs and small perennial streams which are characteristic of the valley sideslopes. Broad floodplains containing alluvial valley fills along Carroll and Neets Creek serve as areas for groundwater recharge and discharge to surface waters. Wetlands within the area serve as a major medium of transport for groundwater along the landscapes hydraulic gradient. Uplands, bogs, and other extensive wetlands on higher landscape positions intercept area precipitation. Much of the water infiltrated, is retained in the high groundwater storage capacity of these wetlands. It is gradually released and donated to fens further down the gradient. These fens, in turn, continue the process by transfer of groundwater to riparian, lacustrine and estuarine areas at the lower end of the hydraulic gradient. Biological agents, beavers, with their construction of ponds and waterways, alter surface flows and create storage and recharge areas throughout these watersheds and are significant and often overlooked factors in the surface and groundwater hydrology of the area.

Watershed Analysis

The Carroll Creek and Neets Creek watersheds were analyzed to characterize the human, aquatic, riparian, and terrestrial features, conditions, processes, and interactions within a watershed (Federal Guide to Watershed Analysis, 1995). The watersheds were divided into sub-basins and reaches. Sediment transport and deposition indices were developed, based upon watershed morphology, discharge, and potential sediment sources (for a detailed description of this process, see Appendix F, Watershed Analysis Report). Stream surveys were conducted to document the existing conditions in the Carroll Creek watershed in the 1994 field season. This survey includes an analysis of Basin Wide Survey (BWS) data, ground verified channel types and Aquatic Habitat Management Unit (AHMU) classes, potential road concerns, and a summary stream management prescription for each harvest unit in the Project Area. Potentially unstable soils and wetlands within the Project Area were identified and evaluated. Areas of riparian soils were identified and mapped. Soil disturbances, potential sources of erosion, and sediment production, (landslides, areas of windthrow, etc.) were inventoried.

The watershed analysis process includes the identification of issues and key elements of the ecosystem that are most relevant to the management objectives and resource conditions in the watersheds. It identified the Riparian Habitat and Fens Landscape Management Zones (See Chapter 2) and Riparian Habitat Conservation Areas (RHCAs) within the Upper Carroll Project Area. Management recommendations that are responsive to watershed processes at a watershed and site specific scale are made. The watershed analysis identifies the importance of the aquatic habitat of the west fork of Carroll Creek and contributes to the deferral of timber management in that sub-basin in Alternatives 3 and 7. It leads to site specific soil, water, and fisheries management recommendations for proposed harvest units and roads (see Unit and Road Cards—Appendix K). The watershed analysis provides an understanding of the watershed context that was essential to guide planning and decision making for the Upper Carroll Project. Watershed analysis contributes to efficiency in meeting land management and regulatory requirements at the watershed and site-specific level.

The focus of this analysis is to evaluate watershed and salmonid habitat in the Neets and Carroll Creek watersheds. The goal of this analysis is to describe the condition of fish habitat as affected by hydrology, geomorphology, soils, vegetation, and climate within the two watersheds. The following objectives must be met to accomplish this goal:

1. Describe existing conditions and trends in watershed processes and habitat conditions.
2. Describe habitat distribution in the watersheds.
3. Identify sensitive areas in the watersheds.
4. Design a strategy to protect sensitive areas and important salmonid habitat.
5. Analyze potential risks associated with proposed management activities.
6. Identify monitoring needs.

Watershed analysis requires the use of both computer models and field inventories. Analytical tools and field analysis are used to determine levels of sensitivity for key areas within each watershed. They are also used to identify areas that are important for maintaining the integrity and function of riparian areas and stream channels related to fish habitat. This analysis also provides a strategy and site-specific recommendations to provide for long term stability of riparian, stream channel, and fish habitat conditions.

The results of the Ketchikan Ranger Districts watershed analysis for Carroll and Neets Creek watersheds is documented in Appendix F—Watershed Analysis Report, in Volume II of the Upper Carroll FEIS.

Effects of the Alternatives

Direct and Indirect Effects

Consumptive Water Use

The effect of the proposed action on the consumptive uses of the water resources of the area will be insignificant in all alternatives. Application of BMPs will maintain water quality for domestic and commercial water uses, as well as the other uses identified earlier.

Stream flow

BMPs applied in the Project Area (see Unit and Road Cards—Appendix K, for site specific application) would reduce the potential for changes in streamflow regimes. See Mitigation Measures, Chapter 2, for a discussion of the stream buffering that will be done under all action alternatives. Where harvest units are dispersed throughout a drainage basin, the effects of destructive rain or snow flood events should lessen.

Water yield responses to timber harvest activities have received very little study in Southeast Alaska's watersheds. Based on the accuracy of the equipment used, no changes in stream flow were measured in the Maybeso watershed following clearcutting of 25 percent of the drainage basin (Meehan et al. 1969). An analysis of Staney Creek drainage basin following a 35 percent clearcut harvest did show significant increases in summer low flows (Bartos 1989).

Several variables (elevation, aspect, basin geomorphology, soils, vegetation, geology, snow storage, and precipitation patterns, cutting unit size, distribution of units within the watershed, and scheduling of harvest entries) could influence stream runoff.

Stream Nutrient Cycling

The results of these investigations suggest that no measurable effects on chemical water quality or aquatic productivity would occur as the result of clearcut harvesting in the Upper Carroll Project Area. Soil and water chemistry monitoring on a small sub-basin that was clearcut and burned in the Pavlof drainage near Tenakee, Alaska measured no loss in total nitrogen and only slight leaching of potassium, magnesium, and phosphorus into surface water (Stednick et al. 1982). Timber harvesting has not been shown to result in detrimental concentrations of dissolved solutes being flushed into surface water bodies (Chamberlin 1982). High concentration of dissolved nutrients that could impair drinking water or aquatic nutrient cycling are of principal concern. Research on coastal forest watersheds have measured only slight releases of key dissolved nutrients resulting from clearcutting and slash burning treatments (Fredriksen 1971).

Water Temperature

Timber harvest in Class III riparian areas may result in minor temperature changes to some streams in the Project Area. By maintaining buffers adjacent to Class I and Class II streams, the effects of harvesting small headwater drainages will be substantially mitigated. A 50- to 80-foot wide stream side buffer has proven to be effective in moderating solar radiation and reducing stream temperature increases (Brown et al. 1971). Stream temperatures in the Project Area do not generally exceed the maximum temperature threshold of 65 degrees F for growth and propagation of fish set by State water quality standards. The majority of Class III drainages in the Project Area originate on mid-to-high elevation mountain slopes. Base flow for these streams is typically supplied by snow-melt runoff, ground-water discharge, or drainage of high elevation lakes and ponds. Channels are typically moderately to deeply incised, with steep gradients and high flow velocities and do not meet typical temperature sensitive criteria.

Dissolved Oxygen

The temperature, gradient, and flow characteristics of the streams in the area generally assure dissolved oxygen contents at or near saturation at most times. The effects of timber harvest and road construction on dissolved oxygen are expected to be negligible for all alternatives.

Sediment

Estimates of sediment delivery to Southeast Alaska streams from timber harvest indicate that sediment increases are minimal and not distinguishable from natural fluctuations in sediment yield. In the Indian River on Chichagof Island, prior to harvest, two years of monitoring was conducted by the Forest Service. In 1978 and 1979, total sediment yield was 0.07 tons/acre and 0.16 tons/acre, respectively. Post harvest monitoring showed sediment yields in 1980 and 1981 of 0.11 and 0.14 tons/acre, respectively (Paustian 1987). Suspended sediment values in Indian River during the study period ranged from 0.19 mg./l to 175 mg./l.

Some increases in sediment delivery to streams above naturally occurring rates can be expected to result from timber harvest and road construction (Rice et al. 1979; Madej 1982; Reid and Dunn 1984; Furniss et al. 1991; Chamberlin et al. 1991).

Sediment may be generated in each action alternative from short-term and long-term land disturbing activities. Sediment production and delivery to streams is roughly proportional to the amount of road constructed, slope gradient, soil type, the amount of use, the number of stream crossings, the proximity of the road to the stream, area of timber harvested, yarding system used, and the amount of naturally produced sediment. Construction of new roads expose soil, which may be eroded and cause sediment delivery to streams. Yarding and road construction on high or very high mass movement index soils may cause landslides that generate sediment. See the Soils, and Roads and Facilities sections of this chapter for detailed effects of yarding and road construction and reconstruction on Mass Movement Index (MMI) soils.

Sediment from management activities may continue to be generated long after roads are constructed, timber is harvested, and stream crossings are in place. Maintenance of road surfaces and ditches exposes soil to erosion. As use is reduced and exposed soil becomes vegetated, the rate of erosion and delivery to streams generally will be reduced (Reid and Dunne 1984). Use of BMPs and filter strips will minimize effects of sediment. The rate and extent of this reduction depends upon the rate of vegetation establishment. Establishment of vegetation may be enhanced by closing roads and seeding exposed soil, as discussed in the Roads and Facilities section of this chapter.

The extent to which stream crossings deliver sediment depends on the maintenance strategy applied after harvest. If BMPs are implemented, such as maintenance of culverts and bridges, little additional sediment is produced.

The proposed alternatives have the potential to affect water quality and fish production in the Carroll Creek system. The potential for direct effects on beneficial uses will depend mainly upon the topography and location of proposed roads and harvest units in relation to stream channels and high landslide potential areas.

The sediment transfer index (Geier and Loggy, 1995) indicates where sediment production and deposition in a watershed is a potential problem for maintenance of aquatic habitat. The quantity of sediment transported and deposited depends upon a number of factors, including nature of sediment source, stream discharge, and channel morphology. These are factors that resource managers must consider when they undertake activities on areas that are linked to important aquatic habitat.

Results of this sediment transport and deposition risk assessment for roads and units in the Upper Carroll action alternatives indicate that Alternatives 3, 6 and 7 have a relatively low overall risk of sediment delivery to streams. By minimizing harvest unit location and road construction near streamcourses in high risk sub-basins and proposing no activities in the Neets Creek watershed, Alternative 7 presents the lowest overall risk of sediment production and delivery to sensitive stream reaches. Alternative 5 presents a higher risk of producing sediment that may affect beneficial uses, mainly by proposing road construction and timber harvest in the west fork of Carroll Creek. Alternative 2 poses the highest risk of sediment delivery from road related sediment and also proposes a number of timber harvest units in the west fork of Carroll Creek and within the Neets Creek watershed.

Water Quality

Application of BMPs and Forest Plan Standards and Guidelines will minimize sediment delivery by controlling surface erosion from roads and harvest units. This will be accomplished by avoiding or minimizing landslide and surface erosion potential, and by proper design and installation of road drainages and stream crossings. There is, however, a risk of catastrophic events, large landslides that may occur naturally and cannot be predicted. The effects of land management activities on fish and other beneficial water uses are complex and not easily quantified. Direct, indirect, and cumulative effects result from potential changes in erosion, sedimentation, stream temperature, recruitment of large woody debris, and the stream nutrient cycle.

To comply with State Water Quality Standards, the Forest Service is required to apply Best Management Practices (BMPs) that are "consistent" with State Forest Practices and other applicable State Water Quality Regulations. The effectiveness of BMPs is determined by the degree to which water quality meets Alaska State Water Quality standards. The State has set numerical standards which include dissolved oxygen, turbidity, temperature, and sediment (ADEC, 1995). Although numerical standards are included in the Alaska State water quality regulations, measurements are difficult to routinely apply to the regulation of non-point sediment sources on road construction and timber sale sites. The Environmental Protection Agency (EPA) has determined that the reasonable implementation, application, and monitoring of BMPs achieves compliance with the input of the intent of the Clean Water Act.

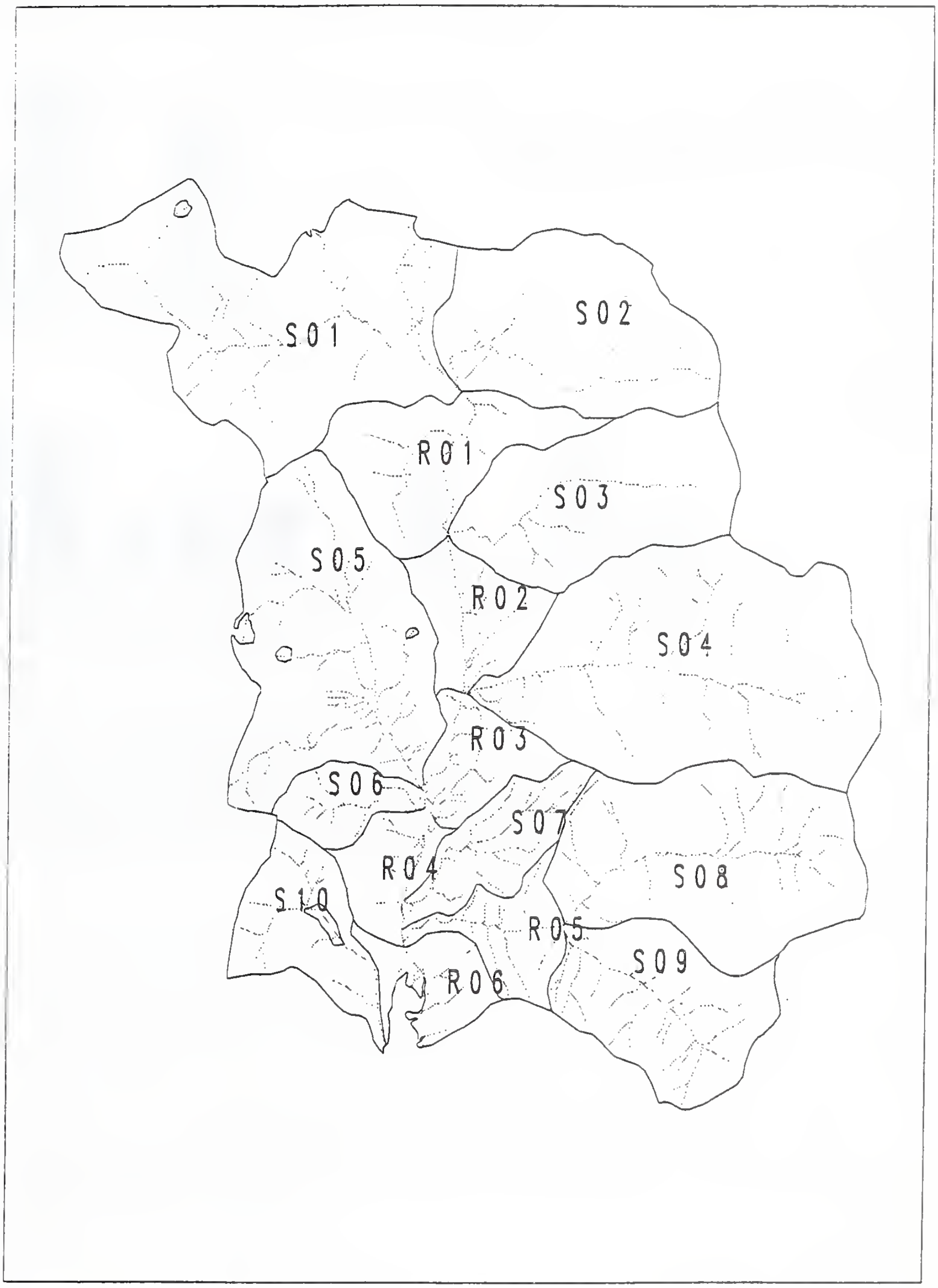
Water quality studies conducted in Southeast Alaska indicate that except for short-term localized deviations from numerical standards, BMPs are effective in maintaining sediment concentrations within State standards (Paustian 1987). The results of these investigations suggests that no measurable effects on chemical water quality or aquatic productivity would occur as the result of clearcut harvesting in the Upper Carroll Project Area. Soil and water chemistry monitoring on a small sub-basin that was clearcut and burned in the Pavlof drainage near Tenakee, Alaska, measured no loss in total nitrogen and only slight leaching of potassium, magnesium, and phosphorous into surface water (Stednick et al. 1982). Timber harvesting has not been shown to result in detrimental concentrations of dissolved solutes being flushed into surface water bodies (Chamberlin 1982). High concentrations of dissolved nutrients that could impair drinking water or aquatic nutrient cycling are of principle concern. Research on coastal forest watersheds have measured only slight releases of key dissolved nutrients resulting from clearcutting and slash burning treatments (Fredriksen 1971). Effects upon water quality in the Neets Creek and Carroll Creek systems will be within State standards in all alternatives.

Sediment may consist of bedload material or suspended sediment (turbidity). The State of Alaska will grant a short-term variance from antidegradation requirements or water quality criteria for a one-time, temporary activity, such as the installation of a road crossing, that is a non-point source of sediment, and for a temporary activity associated with the placement of fill material affecting a specific water body. Specific activities of this nature are identified in the Unit and Road Cards—Appendix K.

Watershed Analysis

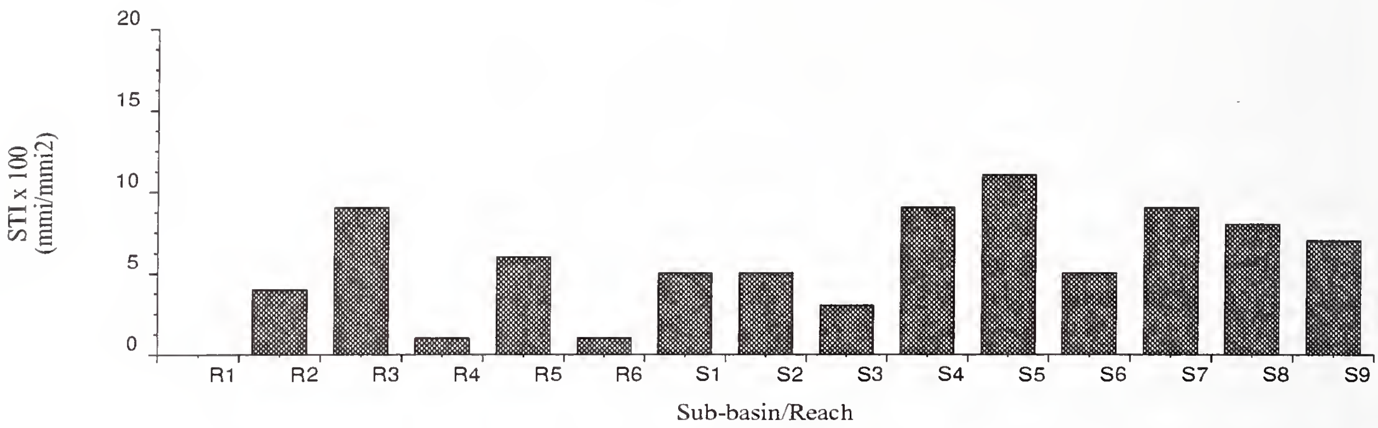
The Carroll Creek watershed analysis indicates that Sub-basins S4 and S5 (Figure Water-1) have the greatest potential for producing sediment and discharging this sediment downstream. Stream Reaches R4 and R6 (Figure Water-1) are those floodplains in the watershed with the greatest potential for sediment to be deposited. These floodplains include a high density of large, low-gradient depositional channels. These areas are the most critical areas for sediment deposition in the watershed. Sediment transported from upstream areas will be deposited in these floodplains.

Figure Water-1
Carroll River Watershed



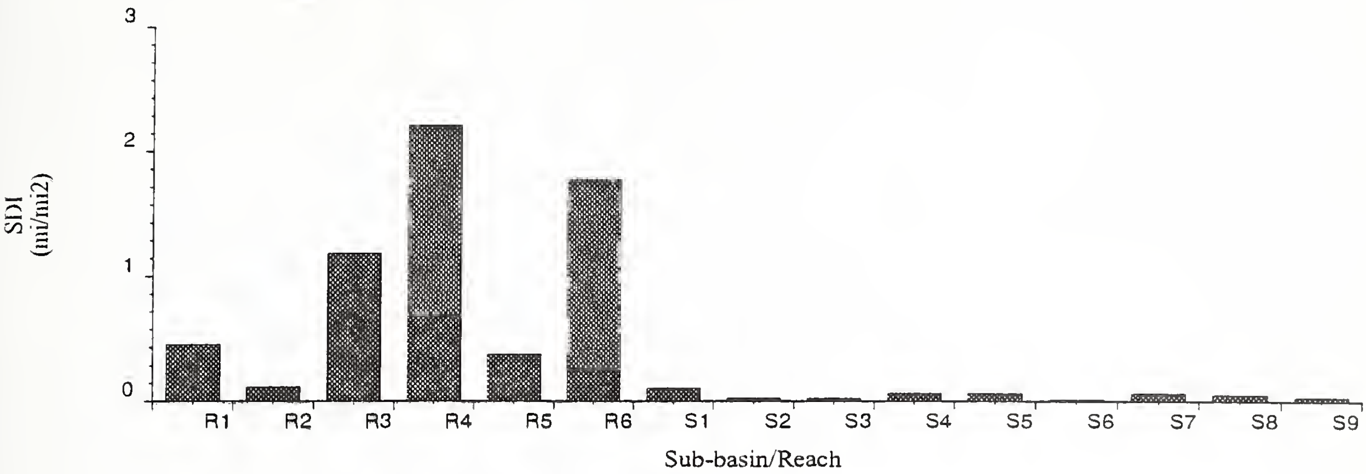
The watershed analysis can be used to identify important hydrologic processes at the watershed level. Streams draining Sub-basins S1 and S2 flow into the main stream in Reach R1, which is a moderate sized, low gradient floodplain channel. After flowing out of R1, the stream gradient increases significantly in Reach R2 and flows through a section of moderate gradient, highly incised channels in stream Reach R3. The main stream channel in Reach R3 is a high energy stream with a series of cascades and falls that drains the upper portions of the watershed.

Figure Water-2
Carroll STI by Sub-basin and Reach



The existing Sediment Transport Index (STI) for each Sub-basin and Reach in the Carroll Creek watershed in shown in Figure Water-2. Sub-basins S4 and S5 have the highest scores, followed by reach R3. These Sub-basins have the greatest potential to transport sediment downstream in large, rapid pulses relative to other Sub-basins. The higher the STI, the greater the potential.

Figure Water-3
Carroll SDI by Sub-basin and Reach



The existing Sediment Deposition Index (SDI) for each Sub-basin and stream Reach is shown in Figure Water-3. Reaches R4 and R6 have the highest scores. These are the most critical depositional Reaches in the watershed. The higher the SDI, the greater the potential for sediment to be deposited in that Reach.

Reach R3 is a critical reach both in terms of fish habitat and hydrology. From the fisheries standpoint, the falls and cascades in Reach R3 provide an effective barrier for anadromous fish migration. From the hydrologic standpoint, Reach R3 drains over half of the watershed and funnels sediment and organic debris in the floodplains downstream. As a result, Reach R4, immediately downstream, is the most sensitive floodplain in the watershed. Stream flow from over half of the watershed flows into this area where logs, gravel bars, and floodplains store sediment.

To summarize, R4, S4, and S5 are the most sensitive areas of the watershed with respect to sediment (Figure Water-4). S4 and S5 have a high transport potential with 44.9 percent and 54 percent, respectively, of their areas in high mass movement soils (MMI 3 and MMI 4). They also have localized deposition and high-complexity fish habitat in their lower reaches. Sediment transported from these Sub-basins is transferred directly to depositional areas in reach R4 where it could adversely affect spawning areas for pink and chum salmon.

In the Neets Creek watershed, Sub-basins S3 and S4 have the highest potential to produce sediment (Figure Water-5). Main stream Reaches R1 and R4 have the highest density of large, low-gradient depositional channels. These are the primary areas where sediment from upstream areas will be deposited.

Figure Water-4
High Risk Sediment Areas for Carroll Creek

Figure Water-5
Neets Creek Watershed

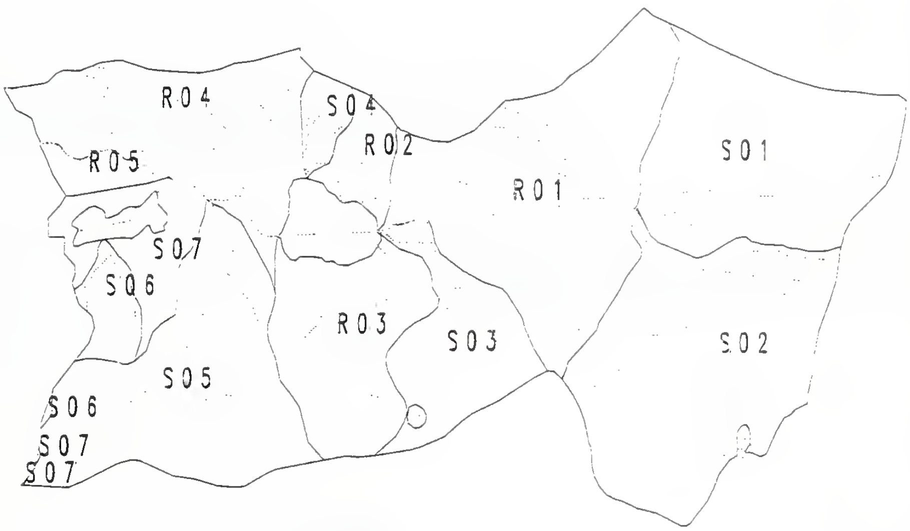
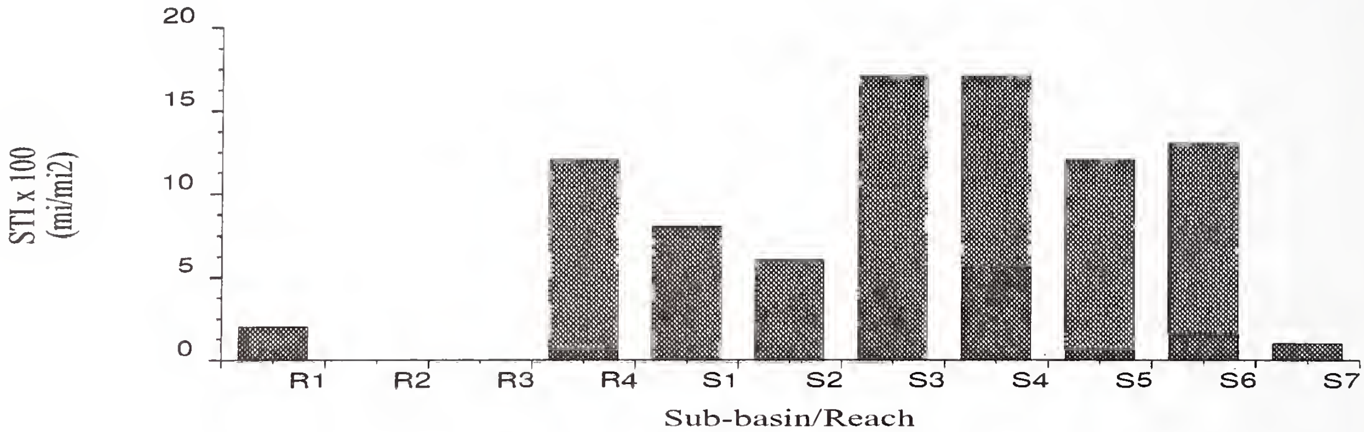
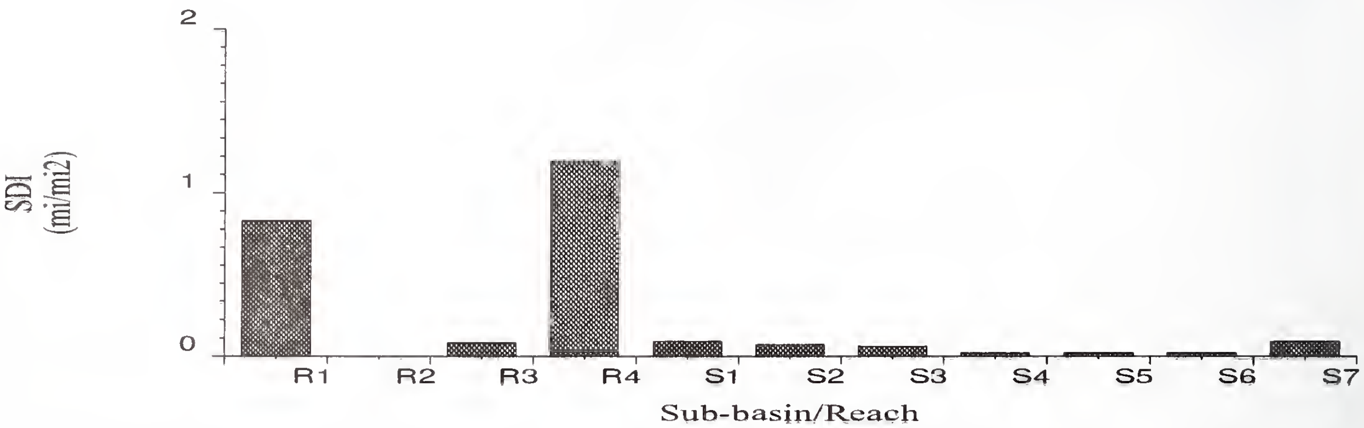


Figure Water-6
Neets Bay STI by Sub-basin and Reach



Areas with the highest STI are Sub-basins S3 and S4 which drain into Bluff Lake (Figure Water-6). These Sub-basins have a higher potential than other Sub-basins to transport sediment downstream in large, rapid pulses.

Figure Water-7
Neets Bay SDI by Sub-basin and Reach

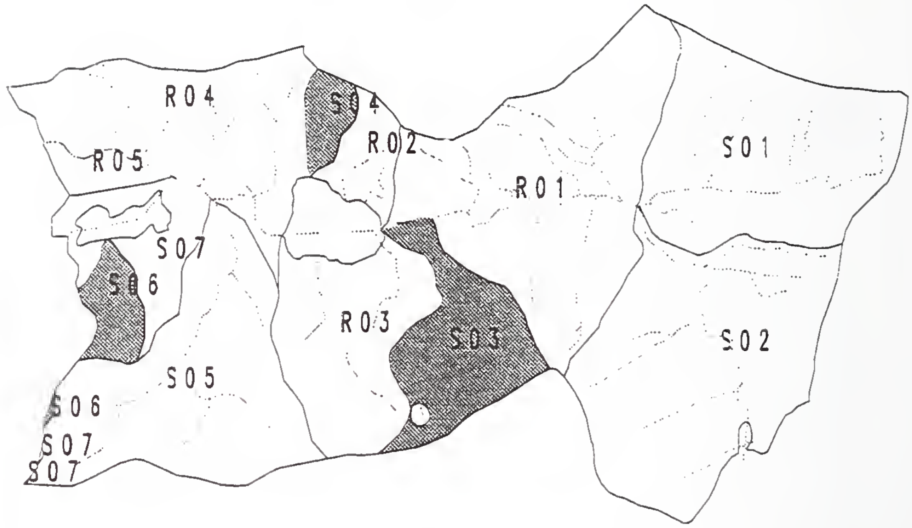


The existing Sediment Deposition Index (SDI) for each Sub-basin in the Neets Creek watershed is shown in Figure Water-7.

The hydrology of Neets Creek has to be interpreted in terms of management concerns. The watershed has no anadromous fish habitat due to migration barriers in the lower parts of the stream. As a result, there are no spawning or winter rearing habitat concerns for salmon in the stream. The stream does however, contain resident cutthroat trout and Dolly Varden char. In addition, the Southern Southeast Regional Aquaculture Association (SSRAA) operates its largest hatchery at the outlet of Neets Creek. Each year the hatchery spawns and rears large numbers of chum salmon, along with smaller numbers of coho and king salmon.

Results of the watershed analysis suggest that Sub-basins S3, S4, and S6 represent areas of highest risk. Reaches R2 and R3 must also be considered because fine sediment flowing into Bluff lake from adjacent hillsides may remain in suspension and enter the fish hatchery water pipeline. Higher risk areas are shaded gray in Figure Water-8.

Figure Water-8
High Risk Sediment Areas: Neets Creek



Individual timber harvest units in each watershed are analyzed for the potential risk to downstream fish habitat. The procedure rates each harvest unit based upon three risk factors, including estimated magnitude of impact, extent of hydrologic connection, and energy available for transport (Geier 1996, in press). The factors were combined into a Delivery Potential Index (DPI) for each harvest unit. The results of this analysis are displayed and described in Appendix F—Watershed Analysis Report.

Riparian Management Strategy

Riparian Habitat Conservation Area Design

Riparian Habitat Conservation Areas (RHCAs) are portions of a watershed that are directly coupled to streams, wetlands, lakes, and ponds. They sustain hydrologic, geomorphic, and ecological processes that affect streams, stream processes, and aquatic habitats (Federal Agency Guide for Watershed Analysis, 1994). These areas include three functional components: stream riparian zones, fens, and sediment source areas. The RHCA is a starting place for site-specific project planning efforts. The delineation of this area on a map (Figure Water- 9) does not prohibit timber harvest, road construction, recreational development, or any other activity within the RHCA.

Figure Water-9
Project Area Map with RHCAs.

These riparian conservation areas occupy portions of the Carroll and Neets Creek watersheds where the potential direct or indirect effects of management activities on fish habitat are significant. They identify the areas of greatest concern for maintaining riparian and wetland functions and hillslope stability. They are tailored to the characteristics of each individual watershed to account for variability in geology, soils, vegetation, and hydrology.

The RHCAs for the Project Area were designed on a watershed scale and adjusted during project level planning. The final RHCA for the Project Area is the combined mapping of several functional resource components. High quality salmonid habitat forms the core of the RHCA. Much of this habitat is found in the floodplain streams and tributaries of Carroll Creek. The stream RHCA component was designed to express riparian forest processes important to salmonid habitat for all Class I and Class II streams. The remaining components and the resource elements that were used to create the RHCAs are riparian vegetation, sensitive soils, sideslope stability, landforms, and stream channel stability

Project Specific RHCA Applications

In accordance with the Riparian Habitat Conservation Area Strategy, the interdisciplinary team (IDT) has made the following project-level decisions in regard to stream and riparian protection:

1. Harvest units are configured to minimize effects on the identified RHCAs. No programmed timber harvest is scheduled within the RHCAs where riparian soils, fens, and MMI 4 soils are located immediately adjacent to the stream corridor.

2. Minimum buffers equal to the height of site-potential trees will be applied to all fish bearing streams.

3. Minimum 300-foot buffers will be implemented on anadromous habitat located in the mainstem of Carroll Creek (equal to or greater than the floodplain area).

4. The sediment delivery potential for each individual harvest unit will be analyzed to determine if buffers are required for Class III streams.

5. All proposed new and reconstructed road will be reviewed by the IDT to evaluate its potential risk and prescribe site-specific road management objectives

Timber Harvest Considerations

Edges of harvest units, including riparian buffer strips, are prone to damage from winds. The direction that a buffer strip is oriented does not always determine whether the buffer will be prone to wind damage. The design of harvest units or road corridors located near or within the stream riparian zones should attempt to minimize blowdown risks and impacts. Where buffer edges of relatively tall trees occur along unit boundaries, innovative management techniques should be used to minimize blowdown risks to the riparian area.

Harvest along Class III mountain slope streams, where stream buffer windthrow and resulting destabilization of stream banks is a major concern, should be considered on a case-by-case basis.

Forest Plan Standards and Guidelines

The TLMP RSDEIS (1996a) provides three options for stream and riparian protection. Option 3 represents current practices on the Tongass National Forest. Option 2 incorporates recommendations from the Anadromous Fisheries Habitat Assessment (AFHA 1995) and Option 1 directs the highest levels of protection.

The preferred alternative presented by the Forest Supervisors (April 8, 1996) designated that Option 2 Standards and Guidelines would be applied to Fish Habitat Integrity Plan 1 (FHIP 1) watersheds. Option 3, or current practices, would be applied to the remaining watersheds. FHIP status is assigned based on pink escapement, coho capability, and sport fish data. The list of FHIP 1 watersheds was cooperatively developed in 1979 by the Forest Service and the Alaska Department of Fish and Game (ADF&G). This list is currently under review.

At this time, VCUs 744 (Carroll Creek) and 737 (Neets Creek) are listed as FHIP 1 watersheds. For this reason, it is recommended the Riparian Management Strategy strive to be consistent with Option 2 of the proposed Standards and Guidelines. If a watershed-level analysis is conducted, Option 2 makes allowances for the use of site-specific prescriptions.

Stream Buffer Prescriptions

Specific buffer widths will be crafted for streams in the Project Area that are in compliance with the Forest Plan Revision (1979), Tongass Timber Reform Act of 1990 (TTRA) and BMPs.

The National Forest Management Act (NFMA), Section 219.27 (12)(e), requires that riparian management areas (RMAs) be established to conserve soil and water resources and to prevent permanent impairment of the productivity of the land. RMAs are not zones of exclusion; rather, they are areas where topography, vegetation, soil, climatic conditions, management objectives, and other factors are to be considered in determining management practices and constraints. RMAs comprise the aquatic and riparian ecosystem, and the adjacent floodplain, wetlands, and upland areas with potential to deliver sediment to channels.

RMAs have distinctive resource values and characteristics. Riparian vegetation is important in maintaining stream bank stability and floodplain integrity. Such vegetation slows water velocity on the floodplain while its roots inhibit erosion along stream and river banks. Riparian vegetation provides shade, leaf and needle litter which fuels aquatic food chains, and large woody debris (LWD), an important component of instream fish habitat.

Current Forest-wide Standards and Guidelines assign buffer prescriptions to maintain the integrity and function of riparian areas. Based on stream class and channel type, prescriptions contain one or more of the following three components: no commercial, no programmed, and uneven-aged buffer widths (Tables Water-1, Water-2, and Water-3). Ground verified information is also used to tailor effective, site-specific riparian prescriptions.

- Where the direction states "no commercial timber harvest", this is a standard and means that commercial timber harvest shall be prohibited (TTRA).

- Where the direction states "no programmed commercial timber harvest", this is a guideline and means that no timber harvest will be scheduled, but that unprogrammed commercial timber harvest could be allowed. Among other reasons, unprogrammed commercial timber harvest may include timber sold as part of salvage sale, for insect and disease abatement purposes, and for specialty wood products. Timber harvest would have to meet the objectives for the riparian area as determined by an analysis of site-specific conditions with an understanding of the watershed functions and stream channel processes.

- Uneven-age management prescriptions utilize both cable yarding and helicopter harvest methods to remove small group or individual tree selections and create a three storied stand. These methods maintain good growth, structural diversity, and the function of the original old growth forest.

- Site-potential tree height refers to the ability of a specific site to grow trees to a certain average height. The reason site-potential tree heights are identified is to give zones of special management which are within or adjacent to a riparian area an ecological foundation. Since large wood recruitment to the aquatic ecosystem is a primary concern, the maximum average tree height is considered to be the greatest width of concern for large wood recruitment. Average maximum tree heights for each channel process group will be used to establish optimum buffer widths.

- The "implementation buffer width" represents the actual buffer width used for harvest unit layout procedure. The implementation buffer widths include areas designated for no commercial, no program, and uneven-aged management. At no time is the implementation buffer less than what is required by TTRA and Forest wide Standards and Guidelines (Figure Water-10).

Table Water-1
Stream, Lake and Estuarine Buffers for Class I and Class II TTRA Streams *

Channel Type	Planning Level RMA Width (ft.) [4]	No Commercial Harvest Width (ft.) [1]	No Programmed Harvest Width (ft.) [2]	Uneven-Aged Management Buffer Width (ft.) [3]	Site Potential Tree Height (ft.)	Implementation Buffer Width Width (ft.) [5]	Normal Occurance[6]
Alluvial Fan							
AF1	100	100			140	140	Y
AF2	100	100			140	140	Y
Estuarine							
ES1	100	100	400		140	500	Y
ES2	100	100	100		140	200	Y
ES3	100	100	100		140	200	Y
ES4	100	100	400		140	500	Y
ES8	100	100	400		140	500	Y
Flood Plain							
FP1	150	100	100		130	200	Y
FP2	150	100	100		130	200	Y
FP3	100	100		100	130	200	Y
FP4	150	100	100		130	200	Y
FP5	150	100	100		130	200	Y
Highly Contained							
HC1	100	100			120	120	N
HC2	100	100			120	120	N
HC3	100	100			120	120	N
HC4	100	100			120	120	N
HC5	100	100			120	120	N
HC6	100	100			120	120	N
Large Contained							
LC1	100	100			100	100	Y
LC2	100	100			100	100	Y
Moderate Contained							
MC1	100	100			100	100	Y
MC2	100	100			100	100	Y
MC3	100	100			100	100	Y
Mixed Moderate							
MM1	100	100			120	120	Y
MM2	150	100			120	120	Y
Plaustrine							
PA1	100	100	100		100	200	Y
PA2	150	100	100		100	200	Y
PA3	100	100		400	100	500	Y
PA4	100	100		400	100	500	Y
PA5	100	100		400	100	500	Y
Lakes and Ponds							
Lakes > 50 acres	100	100		400	100	500	Y
Lakes >5 and <50	100	100		400	100	500	Y
Lakes < 5 acres	100	100		400	100	500	Y

1) No commercial harvest allowed within this zone.
2) No programmed commercial harvest allowed within this zone.
3) Only selective harvest or uneven-aged management will be allowed within this zone.
4) Represents the minimum riparian management area required for consideration under the Forest Plan.
5) Represents the project specific buffer width that will be used for the Upper Carroll EIS.
6) Denotes whether this channel type normally occurs in this stream classification.
* Buffer widths reflect horizontal distance extending from one side of the stream channel.

Table Water-2
Stream, Lake, and Estuarine Buffers for Non-TTRA Class II Streams *

Channel Type	Planning Level RMA Width (ft.) [4]	No Commercial Harvest Width (ft.) [1]	No Programmed Harvest Width (ft.) [2]	Partial Cut Buffer Width (ft.) [3]	Site Potential Tree Height (ft.)	Implementation Buffer Width Width (ft.) [5]	Normal Occurance[6]
Alluvial Fan							
AF1	100	25		35	140	140	Y
AF2	100	25		35	140	140	Y
Estuarine							
ES1	100				140	140	N
ES2	100				140	140	N
ES3	100				140	140	N
ES4	100				140	140	N
ES8	100				140	140	N
Flood Plain							
FP1	150	25		35	130	130	N
FP2	150	25		35	130	130	N
FP3	100	25		35	130	130	N
FP4	150	25		35	130	130	N
FP5	150	25		35	130	130	N
Highly Contained							
HC1	100			100	120	120	N
HC2	100			100	120	120	N
HC3	100			100	120	120	N
HC4	100			100	120	120	N
HC5	100			100	120	120	N
HC6	100			100	120	120	N
Large Contained							
LC1	100		25		100	100	Y
LC2	100		25		100	100	Y
Moderate Contained							
MC1	100			100	100	100	Y
MC2	100			100	100	100	Y
MC3	100			100	100	100	Y
Mixed Moderate							
MM1	100			25	120	120	Y
MM2	150			60	120	120	Y
Plaustrine							
PA1	100		100		100	100	Y
PA2	150		100		100	100	Y
PA3	100			100	100	100	Y
PA4	100			100	100	100	Y
PA5	100			100	100	100	Y
Lakes and Ponds							
Lakes > 50 acres	100		100	400	100	500	Y
Lakes >5 and <50 acres	100			100	100	100	Y
Lakes < 5 acres	100				100	100	Y

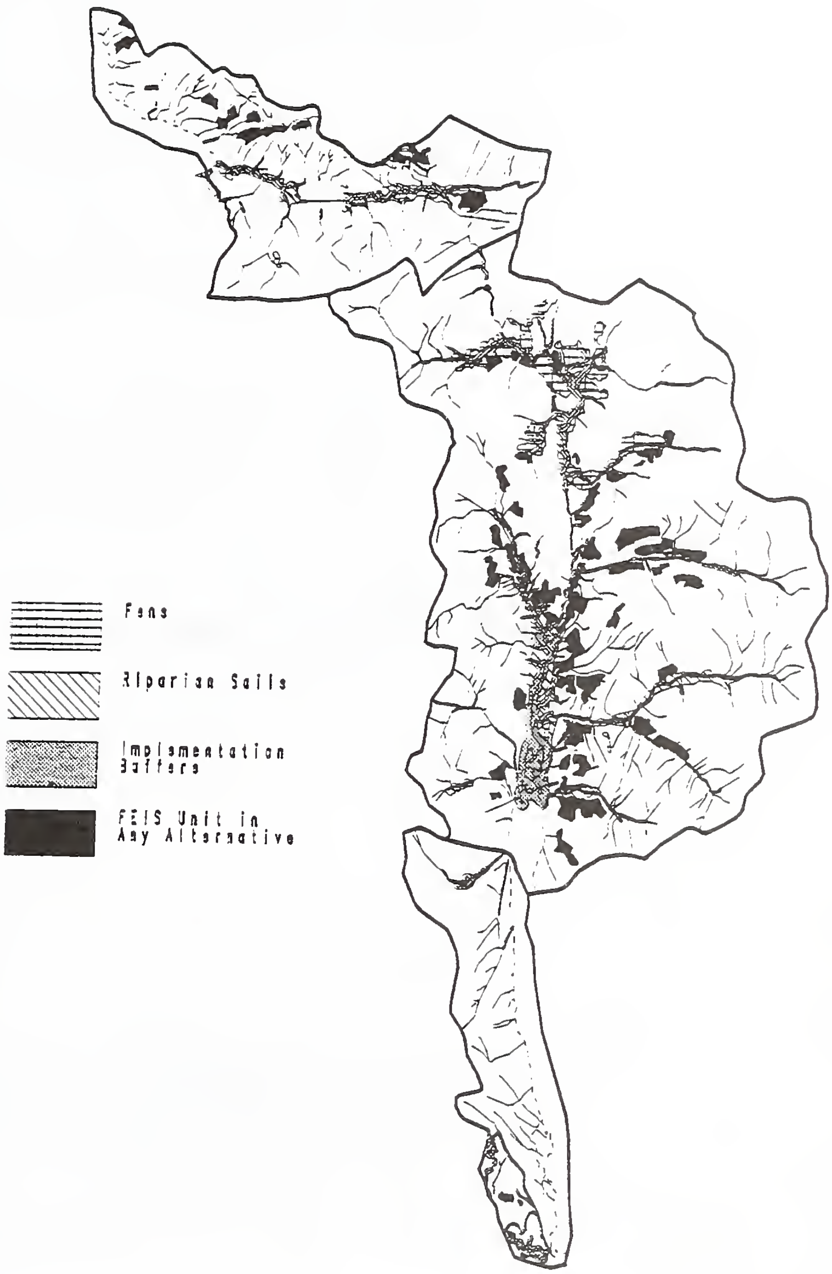
1) No commercial harvest allowed within this zone.
2) No programmed commercial harvest allowed within this zone.
3) Only selective harvest or uneven-aged management will be allowed within this zone.
4) Represents the minimum riparian management area required for consideration under the Forest Plan.
5) Represents the project specific buffer width that will be used for the Upper Carroll EIS.
6) Denotes whether this channel type normally occurs in this stream classification.
* Buffer widths reflect horizontal distance extending from one side of the stream channel.

Table Water-3
Stream, Lake and Estuarine Buffers for Class III Streams

Channel Type	Planning Level RMA Width (ft.) [4]	No Commercial Harvest Width (ft.) [1]	No Programmed Harvest Width (ft.) [2]	Partial Cut Buffer Width (ft.) [3]	Site Potential Tree Height (ft.)	Implementation Buffer Width Width (ft.) [5]	Normal Occurance[6]
Alluvial Fan							
AF1	100		25		140	25	Y
AF2	100		25		140	25	Y
Estuarine							
ES1	100				140	0	N
ES2	100				140	0	N
ES3	100				140	0	N
ES4	100				140	0	N
ES8	100				140	0	N
						0	N
Flood Plain							
FP1	150		25		130	25	N
FP2	150		25		130	25	N
FP3	100		25		130	25	N
FP4	150		25		130	25	N
FP5	150		25		130	25	N
Highly Contained							
HC1	100				120	0	Y
HC2	100				120	0	Y
HC3	100				120	0	Y
HC4	100				120	0	Y
HC5	100				120	0	Y
HC6	100				120	0	Y
Large Contained							
LC1	100				100	0	N
LC2	100				100	0	N
Moderate Contained							
MC1	100				100	0	N
MC2	100				100	0	N
MC3	100				100	0	N
Mixed Moderate							
MM1	100			25	120	25	N
MM2	150			25	120	25	N
Plaustrine							
PA1	100				100	0	N
PA2	150				100	0	N
PA3	100				100	0	N
PA4	100				100	0	N
PA5	100				100	0	N
Lakes and Ponds							
Lakes > 50 acres	100			100	100	100	N
Lakes >5 and <50	100			100	100	100	N
Lakes < 5 acres	100				100	100	Y

1) No commercial harvest allowed within this zone.
2) No programmed commercial harvest allowed within this zone.
3) Only selective harvest or uneven-aged management will be allowed within this zone.
4) Represents the minimum riparian management area required for consideration under the Forest Plan.
5) Represents the project specific buffer width that will be used for the Upper Carroll EIS.
6) Denotes whether this channel type normally occurs in this stream classification.
* Buffer widths reflect horizontal distance extending from one side of the stream channel.

Figure Water-10
Map of Implementation Buffer, Adjacent Riparian Soils, and Fens



Road Management Considerations

A fish stream is defined as any water flow that is accessible to fish and capable of supporting aquatic life. This includes, but is not limited to, all ADF&G designated streams and all their tributaries up to impassable natural barriers. Freshwater systems above blockages may also support resident fish stocks. Evaluation and recommendations will be made by a fisheries biologist during route locations to determine the presence of fish or fish habitat.

The objective of providing fish passage is to not interrupt the natural migration of anadromous and resident salmonids. Fish populations depend upon a mixture of habitat types for growth and reproduction. The incorporation of fish passage facilities at stream crossings should be based on assessments of the life cycle requirements of fish species, of habitat quality, and the accessibility of sites to fish.

The choice of crossing location is very important in terms of both sedimentation effects and fish passage. Stream reaches with uniform alignment, good bank stability, and uniform gentle gradients are the easiest to cross with provisions for fish passage.

Guidelines in the Aquatic Habitat Management Handbook (AHMU) recommend that fish passage be provided on all streams with natural gradients of four percent or less using typical designs for bridges and culverts installed at a grade of one percent or less. Streams with gradients greater than four percent are evaluated by fisheries biologists on a site-specific basis.

The seasonal timing of instream construction operations are most often prescribed as a resource protection requirement for Class I streams. Timing may be recommended on Class II and sometimes Class III streams. Timing recommendations are based on the site-specific and downstream impacts to: spawning, egg presence, fry emergence, and migration of smolts (BMP 14.6). The general windows are listed in the following Table Water-4.

Table Water-4
Timing Windows for Instream Construction.

Species	Timing Window
Pink/Chum	June 1 to August 7
Sockeye	July 18 to August 15
Coho	June 15 to September 1
Steelhead	July 18 to August 15

The dates for the general windows represent a period during which instream work can be conducted. For example, if pink salmon are present, all instream work must be done between June 1 and August 7. However, if both pink salmon and steelhead are present, the timing window is shortened to July 18 to August 7.

Final timing and construction windows are to be determined from a review of site and stream specific information. Variances from the general windows are allowed on a case by case basis, particularly with implementation of the appropriate mitigation measures as prescribed by fisheries biologists.

Additional recommendations for design and maintenance of the road system to maintain riparian and wetland function and fish habitat include:

- With the Project Area, avoid or minimize the amount of new road construction through fens. Roads located on fens can impede the natural water movement associated with these areas and generally require a high density of drainage structures. Fens often contain numerous Class I and II channels that provide high value fish habitat and will therefore require special passage and/or timing restrictions. Roads located within fens usually require high maintenance due to beaver activity.

- Avoid crossing active alluvial fan channel areas. Where possible locate crossings at the apex of the fan where the stream is still relatively contained. If the fan must be crossed, oversized and extra drainage structures are recommended.

- Remove all drainage structures in sensitive areas where fish passage, beaver habits, and unstable stream channels are a concern unless routine road drainage maintenance is feasible. Close all temporary roads and use water bars to control road drainage.

- Construction of roads, particularly mid-slope roads, in sediment source areas should be avoided. Roads in these sensitive areas have potential for accelerating large scale mass wasting and have a high likelihood of direct sediment delivery to anadromous and resident fish habitats.

Anadromous Fisheries Habitat Assessment Recommendations

The Upper Carroll project implements the recommendations applicable to project-level planning presented in the Anadromous Fish Habitat Assessment (AFHA) report of January 1995. Examples of implementing these recommendations include the following.

- Classification of streams draining intermittent and ephemeral channels will apply to the Project Area as outlined by the Regional Forester in a letter dated November 21, 1996. The letter provides a definition of TTRA language of "...flows directly into", clarifies stream class definitions of Class I, II, III and adds new Class IV and non-stream categories.

- Fish habitats and communities were inventoried and characterized with the Region 10 Basin Wide Survey Protocol (1994). The ground verified data was incorporated into the Geographic Information System (GIS) and used for project-level planning.

- During field reconnaissance, areas with steep slopes, high hazard soils, and Class III streams were identified and evaluate for risk of adverse impacts on headwater channels. BMPs listed on the individual unit and road cards are prescribed to reduce the risk of on-site erosion and delivery of sediment to a stream channel.

- Watershed-level analyses are provided for the Neets Bay and Carroll Creek watersheds. Additional site-specific analysis is used to address the potential delivery of sediment from Class III to Class I and II streams. The intent of this site-specific analysis is to determine where increased protection of headwater areas is required to deter long-term, downstream impacts to fish habitat.

- Site-specific stream side buffers are provided for floodplain and confined alluvial channels. Harvest units adjacent to Class I and Class II stream channels were investigated by project fisheries biologists to determine the extent and type of buffer necessary to assure protection of any small, off-channel streams associated with floodplains and to provide a long term source of woody debris. After further analysis, some stream side buffers have been enlarged to encompass adjacent riparian soils and fens.

- Increased monitoring on implementation and effectiveness of procedures for anadromous fish habitat are addressed later in this document. These procedures include: cross-sectional transects established in Carroll Creek to monitor changes in channel morphology over time, thermographs installed to monitor stream temperature, and plans to conduct road condition surveys two, five, and ten years after road construction to identify maintenance concerns.

The remaining eight recommendations are beyond the scope of this project and are being addressed in the TLMP RSDEIS (1996a) or by the Tongass Forest Supervisors and the Regional Director of Wildlife, Fisheries, Ecology, and Watershed.

Cumulative Effects

All major watersheds within the Project Area have experienced prior roading and timber harvesting. BMPs would largely limit most effects of sediment and increased flows from roads and harvest units (see Unit and Road Cards—Appendix K for site specific application). By 2140, all the suitable and available forested land within the Project Area will be harvested and the transportation system will be constructed. This will result in a mosaic of forest stands of varying age, structure, and composition.

Application of BMPs and adherence to Standards and Guidelines in the future will assure that the effects upon water resources are minimal.

Table Water-5 displays the percent of the watershed harvested and roaded in the past, proposed harvest for this project by alternative, and additional total harvest to the years 2004 and 2140. Effects are expected to be greater in those drainages with the highest percentages of harvest. The Neets Creek watershed will see the greatest effects of timber harvest and road construction by 2140; approximately 42 percent of the area of that watershed.

Table Water-5
Cumulative Watershed Effects, Percentage of Watershed Harvested and Roaded

VCU	Harvested and Roaded Before 1995	Harvested and Roaded by 1997 Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7	Harvested and Roaded By 2004	By 2140
Carroll Creek	2	2	8	5	6	5	2	10	17
Neets Creek	39	39	42	39	39	39	39	42	42
North Saddle Lakes	3	3	23	22	18	18	22	23	25

SOURCE: Babik 1996

This risk of unplanned events and cumulative effects is related to the amount of timber harvest, rate of harvest, and location of roads within a watershed. Although the amount of risk cannot be quantified, the frequency of such events in the past has been low, and the risk of future unexpected detrimental effects should be minimal because of the implementation of standards, guidelines, and other protective measures (see Marine Environment and the LTFs section of this chapter.)

Table Water-6 displays the percent of watershed affected by existing and proposed ground disturbing activities and associated roading during the 15-year period, 1982-1997.

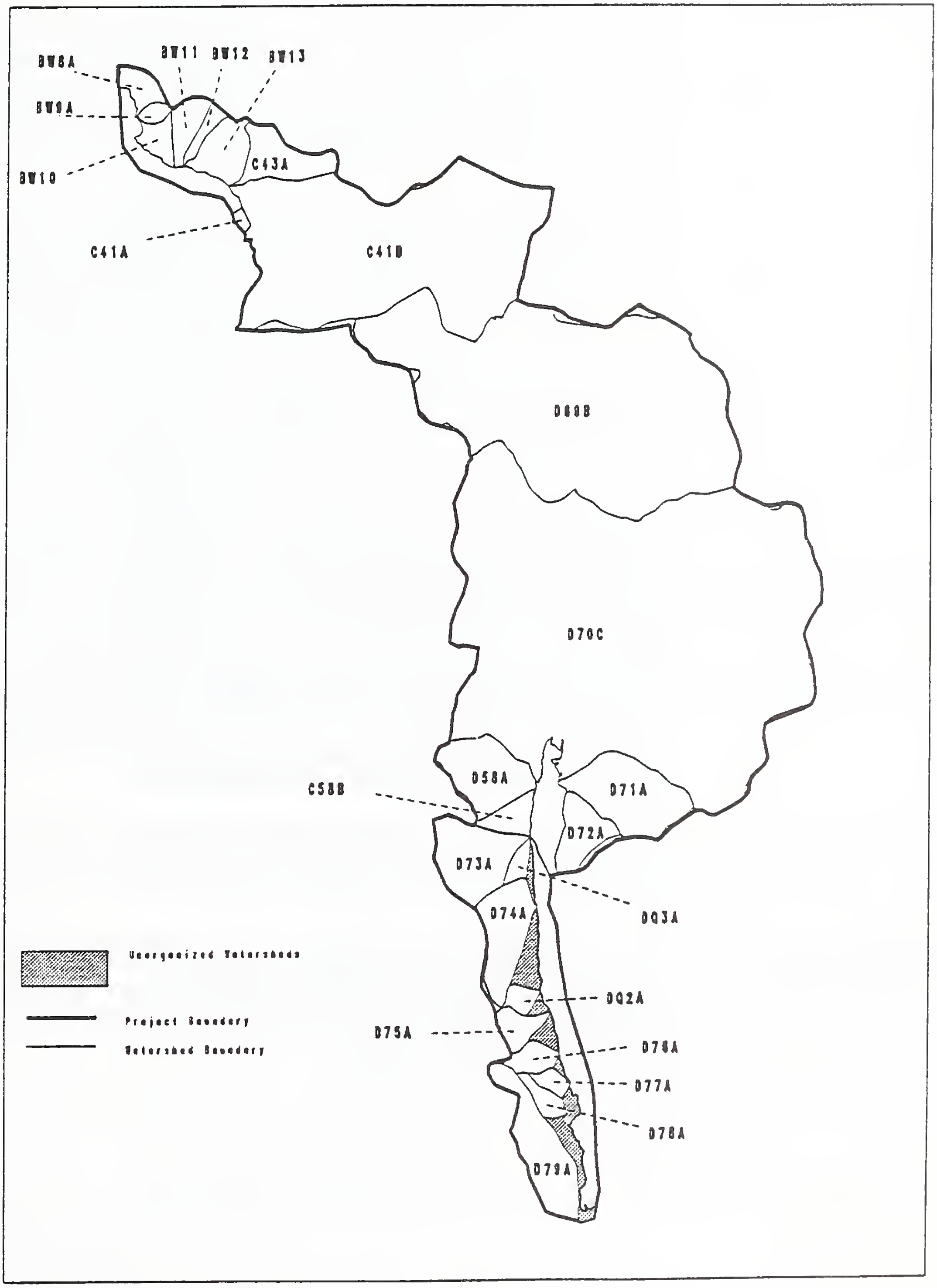
Table Water-6
Cumulative Watershed Effects, Percentage of Watershed Harvested and Roaded in Third Order or Larger Watersheds

		Percent Watershed Harvested and Roaded 1982-1997					
Watershed Name	**Watershed Number**	**Alt. 1**	**Alt. 2**	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Neets Creek	C41B	0	3	0	1	0	0
Neets Bay Overlook	C43A	0	19	0	19	0	0
Carroll Estuary West	C58A	0	4	0	0	0	3
Upper Carroll Creek	D69B	0	3	1	2	2	0
Lower Carroll Creek	D70C	0	8	5	6	5	2
Carroll Estuary East	D71A	0	4	8	11	3	3
Swan Falls Overlook	D74A	0	1	0	0	0	0
North Saddle Lakes	D79A	10	23	22	18	18	22
Upper Salt Creek	D80B	0	0	0	0	0	0

SOURCE : Babik 1996

Figure Water-11 displays the location of all primary watersheds, including the third order and larger watersheds, within the Project Area.

Figure Water-11
Map of Upper Carroll Primary Watersheds



Effects on Water Quality Outside the Project Area

The harvest of timber within the Upper Carroll Project Area will indirectly influence water quality at the Ketchikan Pulp Corporation's facilities at Ward Cove and Thorne Bay, Alaska. Processing of timber harvested from the Upper Carroll Area at the log sort yard at Thorne Bay and the pulp mill at Ward Cove may affect water quality in those areas.

Evaluation of the potential impacts of KPC's activities upon water quality at these sites is the responsibility of the Federal Environmental Protection Agency (EPA) and are fully disclosed in a separate Alaska Department of Environmental Conservation (ADEC) Information Request Work Plan. Emissions impacting water quality at KPC facilities are permitted by the EPA and certified by the ADEC. KPC's discharges into the waters of Ward Cove and Thorne Bay under permits issued and certified by these agencies. As such, an analysis of these effects in the Upper Carroll FEIS would be redundant and outside the scope of this FEIS.

KPC has proposed to extend one of its existing National Pollutant Discharge Elimination System (NPDES) permitted wastewater outfalls from Ward Cove to a new location in Tongass Narrows. KPC has prepared a number of documents to support its request for an NPDES permit for the extended outfall, including "Outfall Extension Study" (ENSR April, 1994); "Mixing Zone Request and Environmental Analysis for Outfall Extension into Tongass Narrows - Revised" (ENSR August, 1994); and "ADEC Information Request Work Plan" (ENSR February, 1995). "ADEC Information Request Work Plan" and the subsequent "Study of Solids Deposition" (ENSR April, 1996) were responses to ADEC's letter of January 12, 1995, requesting additional information about the extended outfall and mixing zone and specifically requesting an ecological and human health risk evaluation of the effluent discharge into Tongass Narrows. These documents provide the screening level assessment of the potential incremental risks to the environment and to human health that might result from exposure to discharges from the extended outfall. This screening level of risk assessment uses conservative estimates for the exposure assessment and the toxicity evaluation. The results demonstrate that little risk is associated with the action being evaluated, indicating that the proposed outfall can be sited safely in Tongass Narrows. Because of the conservative approach used, a further evaluation of risk is not considered necessary. Presented in the documents are the methods, assumptions, and calculations used to develop the quantitative screening level assessment of the incremental risks to the environment and human health. The "ADEC Information Request Work Plan" includes: (1) a description of the project background; (2) the conceptual site model; (3) estimation of exposure point concentrations; (4) ecological risk assessment; (5) human health risk assessment; and (6) a summary of risk assessment results.

For further information on the effect of KPC's operations on water quality at Ward Cove and Thorne Bay, contact the EPA Region 10 Office in Seattle, Washington, or the Alaska Department of Environmental Conservation offices in Ketchikan or Juneau, Alaska.

Swan-Tyee Transmission Line

Construction of the Swan Lake-Lake Tyee power transmission line through the Upper Carroll Project Area is analyzed in the Swan Lake-Lake Tyee Intertie Draft Environmental Impact Statement, issued March 1996. This DEIS examines in detail issues related to the construction of this power transmission line right-of-way. The effects upon water quality have been analyzed and disclosed.

Geology, Minerals, and Cave Resources

Key Terms

Alluvium—sand, silt, clay, and gravel laid down by a river or stream.
Carbonate rock—rocks, such as limestone and dolomite, which contain a high content of calcium carbonate, $CaCO_3$.
Cirque—a circular basin, a natural amphitheater formed at the head of mountain valleys by glacial erosion.
Diorite—a granular igneous rock made up of mainly feldspar and hornblende.
Fjord—a long, narrow arm of the sea, bordered by steep cliffs, formed by glacial erosion
Gabbro—a granular igneous rock made up of mainly dark colored minerals, labradorite and augite.
Glacial till—gravel, boulders, sand, and finer materials transported and deposited by a glacier.
Graywacke—fine-grained, sedimentary rock made up of fragments of slate or schist.
Isocline—a fold of geologic strata so tightly compressed that the parts of each side dip in the same direction.
Karst—a type of topography that develops in areas underlain by soluble rocks, primarily carbonate rocks such as limestone. Sinkholes and caves are formed when the subsurface layer dissolves.
Lithology—the science dealing with the mineral composition and structure of rocks.
Phyllite—a slaty rock with lustrous surfaces due to the high content of mica flakes.
Pleistocene—the epoch forming the first half of the Quaternary period, originating about one million years ago.

Affected Environment

The geology of the central part of Revillagigedo (Revilla) Island affects all of the areas other physical and biological characteristics. The geological characteristics of the Project Area may be described by the geomorphological, lithological, and structural geology.

Geomorphology

The Upper Carroll Project Area has been heavily modified by Pleistocene and post-Pleistocene glaciation. The Project Area is characterized by fjords, glaciated valleys, and ridges that trend in an east-west direction from the former centers of glacial origin in the mountains to the east. The features characteristic of glaciated coastal areas are easily recognized in the Project Area. Southeast Alaska has one of the best developed fjord systems in the world, deep sea channels, such as Carroll Inlet and Neets Bay, carved to great depths by coastal glaciers. The steep topography adjacent to the shore in much of the Project Area make poor sites for log transfer facilities (LTFs) and other shore access developments. One of the most striking characteristics of a well-developed glaciated valley is the U-shape of its cross profile, with a nearly level valley floor, filled with glacial debris, and considerably over-steepened side-walls, approaching vertical in places. Terrain of this nature typically has

good sites for the growth of commercial tree species on the valley floor and lower sideslopes. The valley sidewalls are usually difficult to access and much of this extremely steep ground is unsuitable for the production of commercial wood products. The Carroll Creek valley and the slopes of Mount Reid to the east are examples of glacial influence. The surrounding ridgetops, with their rounded profiles and relatively low relief, are characteristic of areas overridden by glacial ice. These ridgetops are often above treeline or are relatively wet sites which do not support stands of commercial timber. While road construction on many of these ridges would be relatively easy, access from the valley below is difficult.

Lithology

The lithology or bedrock geology of the central part of Revilla Island consists mainly of a group of metamorphosed and deformed rock strata including dark-gray slate, phyllite and graywacke, andesitic or basaltic volcanic rocks, conglomerates and inclusions of gabbro, and diorite. Running through these bedded rocks are locally abundant dikes and sills of granodiorite and quartz-diorite. While the masses of gabbro and diorite which make up the core of these mountains form relatively stable structures, the slates, phyllites, and graywackes which overlay or are adjacent, form landscapes susceptible to landslides and other erosional processes. Quartz-diorite and granodiorite probably make the most competent road surfacing material in the Project Area. The gabbro and diorite are typically less competent. Slates, phyllites, and graywackes break down rapidly into fine material when used on road surfaces. All of these rocks are adequate for base material, although the quartz-diorite and granodiorite are often difficult to reduce into proper sized material.

Structural Geology

The geologic structure of the Project Area consists mainly of a series of southwest trending overturned isoclines that are cut by high-angle faults. The bedded nature of the slates, phyllites and graywackes that make these isoclines, particularly when oriented parallel to the ground slope, provide failure plains that facilitate landslides and other slope failures. Numerous minor faults give the landscape much of its characteristic structure, with numerous parallel, acutely, and obtusely intersecting drainage features.

Minerals

Minerals are legally divided into three groups: locatable minerals, leasable minerals, and saleable minerals.

Locatable Minerals

A locatable mineral is any mineral which is ''valuable,'' in the usual economic sense, or has a property that gives it distinct and special value. Examples of locatable minerals on the Tongass National Forest are gold, silver, copper, molybdenum, iron, nickel, lead, and zinc. There are no known mining claims located within the Project Area. The potential for location and development of locatable minerals in the Project Area appears to be low (Coldwell 1989).

Leasable Minerals

Federally-owned leasable minerals include oil, gas, coal, geothermal resources, potassium, sodium, phosphates, and sulfur. Presently, there are no leasable mineral applications or pending applications, prospecting permits, or geophysical exploration permits on the Project Area. No leasable mineral commodities are presently being produced on the Tongass National Forest. The anticipated demand for leasable minerals is expected to remain low. There is one known geothermal area near the Project Area, the Bell Island hot spring, just to the north.

Saleable Minerals

Saleable, or ''common variety,'' minerals include sand, rock, building stone, gravel, and other similar materials. The predominant saleable commodity in the Project Area is crushed rock used to construct roads. There are also deposits of sand and gravel throughout the area.

Cave Resources

The only known occurrences of carbonate rock within the Project Area are in the North Saddle Lakes vicinity (Berg 1988) and along Carroll Creek. Within the Project Area, Shelter Cove Harvest Unit Number 18 is known to contain carbonate rock and small scale karst features. Cave resources in this area were identified as being not significant during the Shelter Cove timber sale implementation (Johnson 1993).

During the development of the Swan Lake-Lake Tyee Intertie Draft Environmental Impact Statement narrow bands of marble within the phyllite and schist bedrock were found along the proposed road route along Carroll Creek. Where the marble rock was found, dissolution features were found in association with it. One feature found appeared to be a vertical entrance to a small cave, but the opening width did not permit entry.

Effects of the Alternatives

Geomorphology

None of the alternatives will have an effect on the geological characteristics or cave resources of the Project Area.

Minerals

The proposed project will have minimal effect upon the locatable and leasable minerals within the Project Area. Expansion of the present transportation system could open more areas for exploration or facilitate future development.

Alternatives 2, 3, 5, 6, and 7 will develop sources of saleable mineral material, crushed rock, for use in the construction of roads throughout the Project Area. Future demand for common varieties of mineral materials in the Project Area is anticipated to remain low.

Cave Resources

The potential for identifying significant cave resources within the Project Area during implementation is low. However, if cave resources are identified that may be affected by the proposed activities, appropriate mitigation measures as outlined in the 1993 Karst Blue Ribbon Panel Report, will be applied during harvest unit layout.

Swan-Tyee Transmission Line

Construction of a Swan Lake-Tyee Lake power transmission line through the Upper Carroll Project Area will have no significant effect upon the geology of the area. Localized bedrock disturbance at the site of transmission line tower installation would occur. Holes will be excavated for the placement of tower footings. Access to some sections of the transmission line may be gained by the construction of some short spur roads from existing forest development roads. Clearing of a transmission line right-of-way will not result in significant changes to the area geology.

Soils and Ecological Landtypes

Key Terms

Alluvium—material deposited by rivers and streams including sediment laid down in river beds, flood plains, and at the foot of mountain slopes and estuaries.
Bedload—sand, silt, and gravel, or soil and rock debris rolled along the bottom of a stream by the moving water.
Bog—a wetland of slow-moving, nutrient poor, highly acidic water formed of peat derived predominantly from sphagnum moss.
Ecosystem—a complete, interacting system of organisms together with their environment (for example a bog, forest, or lake).
Fen—a wetland of slow-moving, nutrient rich, often alkaline water with sedge peat forming the substrate.
Glacial Till—gravel, boulders, sand, and finer materials transported and deposited by a glacier.
Mass Movement Index (MMI)—rating used to group soil map units that have similar properties with respect to the stability of natural slopes.
Muck—decomposed plant material, with little evidence of the original plant remaining.
Muskeg—a type of bog that has developed in depressions or flat areas; poorly drained, acidic, with organic soils that support vegetation that is predominantly sphagnum mosses and heaths.
Riparian area—the area including a stream channel, lake, or estuary bed; the water itself; and the plants that grow in and on the land next to the water.
Sediment—solid materials, in suspension or transported by water, gravity, ice, or air.
Slip plane—closely spaced surfaces along which differential movement takes place in rock.
Soil productivity—capacity of a soil to produce plant growth, due to the soil's inherent chemical, physical, and biological properties.
V-Notch—a shallow to deeply cut stream drainage, generally in steep, mountainous terrain; would look like a "V" from a frontal view.
Windthrow—areas where trees are uprooted, blown down, or broken off by storm winds.

Affected Environment

Ecological Landtypes

In Southeast Alaska, terrestrial ecosystems have been classified on the basis of natural soil-vegetation complexes (Stephens et. al. 1969, Babik, 1995). The ecological landtypes include soils and ecosystems of Southeast Alaska, and are grouped into "associations" with broad vegetation-soil environment similarities. The families are subdivided into "ecological landtypes". Within each type, species composition, productivity, secondary plant succession, and ecosystem functions are similar. Ecological landtypes are subdivided into "phases," based on soil and geomorphology characteristics such as soil depth, substratum character, or landform. The ecological landtypes in the Upper Carroll are displayed in Table Soils-1.

Table Soils-1
Ecological Landtypes

		Acres within Project Area
Estuarine Meadow Ecological Landtypes		
D1	Sedge meadow ecosystem	0
D2	Hairgrass meadow ecosystem	0
D3	Beach ryegrass and silverweed ecosystem	22
Forest Ecological Landtypes		
F1	Deep, well-drained soils, high site productivity	2,498
F1t/f1t	Young forest ecosystems on alluvial soils, very high site productivity	1,421
F12	Shallow to deep, well-drained soils, high site productivity	1,063
F2/F2r	Shallow to very shallow, well-drained soils over bedrock, moderate to high site productivity	8,257
F3	Moderately deep, well drained soils, moderate site productivity	0
F4	Deep, somewhat-poorly drained, low productivity soils	205
F5	Deep, poorly drained soils, very-low site productivity	971
F6	Somewhat poorly drained soils of subalpine zone	1,812
Muskeg Ecological Landtypes		
M1	Sphagnum bogs, deep fibrous peat	61
M2	Sedge and heath dominated bogs and fens	27
M3	Tall sedge fens, deep peat, and muck	218
MF5	Complex of sphagnum bogs, sedge fens, and forested wetlands	4,205
Alpine Ecological Landtypes		
A1	Alpine heathlands	0
A2	Alpine sedge meadows	159
AF6	Complex of alpine meadows, heathlands and subalpine forestland	7,273
Brush-slope Ecological Landtypes		
B	Avalanche tracts and snowload slopes dominated by Sitka alder	5,946

SOURCE: Babik, 1996

This ecological landtype classification should not be confused with the soil classification system. Because the criteria used to classify soils are not always ecologically significant in Southeast Alaska, some soil types occur in more than one ecosystem type, and some ecosystem subtypes contain several closely related soils. The ecological landtype classification is designed to stratify the landscape of Southeast Alaska into practical ecological landtypes to serve as a basis for interpretation and management. For a more detailed description of the ecological landtypes of Southeast Alaska see, a *Field Guide to the Ecological Classification and Inventory System*, Babik, 1995.

Pojar and MacKinnon (1994), described the following forest and non-forest areas of regional vegetation for Southeast Alaska:

Plant Communities

Alpine Heaths

Alpine Heaths occupy high elevations throughout most of the northern Pacific coastal region, above 2,000 to 2,500 foot elevation. Heaths characteristically are dominated by dwarf, shrubby, evergreen members of the heather family, with other common species such as black crowberry, partridge-foot and bird's-beak lousewort. The ground cover forms a springy carpet, often so dense it obscures everything underfoot, including rocks and holes. Alpine heaths are similar to the A1 Ecological Landtype of Babik (1995) and typically include the Hydaburg soil series.

Mountain Meadows

Mountain Meadows are less extensive than heaths, but are lush, intensely green, and dominated by herbs. Typical species include arrow-leaved groundsel, subalpine daisy, Sitka valerian, arctic lupine, Indian hellebore, gentians, sedges, and grasses such as purple mountain hairgrass. Mountain meadows are analogous to the A2 Ecological Landtype and typically include the Sunnyhay soil series.

Alpine Rocklands

Alpine Rocklands include rock outcrops, cliffs, boulder fields, fellfields, talus and scree slopes, wet runnels, gullies, and avalanche tracks. The plant cover is usually sparse and discontinuous, but it includes many different saxifrages as well as ferns, buttercups, sedges and many species of lichens and bryophytes.

Subalpine Forest

Subalpine Forest is characteristic of areas with a substantial, persistent winter snowpack. These conditions prevail only at high elevations, generally above 1,500 feet. Mountain hemlock and yellowcedar are the characteristic species, although subalpine fir can occur in drier, colder areas. Sitka spruce can also be a significant element of the subalpine forests. This is similar to the F6 ecological landtype of Babik, 1995, and typically includes the St. Nicholas and Tolstoi soil series.

Perhumid Rainforest

Perhumid Rainforest dominates low and middle elevations. Western hemlock is the most common tree in this zone. Sitka spruce is common throughout, especially along rivers and shorelines. Alaska yellowcedar and western redcedar are restricted to wet sites, where they are usually small or stunted and often occur with mountain hemlock. The perhumid rainforest includes the F1, F2, F4, and F5 Ecological Landtypes. The dominant soils are the Kupreanof, Tolstoi, and Maybeso series.

Freshwater Marshes and Fens

Freshwater Marshes and Fens occur where freshwater carries relatively high amounts of nutrients and are not highly acid. They are dominated by sedges and grasses, Sitka sedge, bluejoint grass, tufted hairgrass, and small-flowered bullrush. Shrubs, such as Douglas spirea, sweet gale, Pacific crab apple, and Sitka willow are common along marsh edges and streambanks. Freshwater marshes and fens are similar to the M2 and M3 ecological landtypes. Common soils include the Kina and Maybeso series. These areas make up the Riparian Fens Landscape Zone described in Chapter 2, Table 2-1.

Bogs or Muskegs

Bogs or Muskegs are highly acid peatlands with stagnant waters that originate as rain or snow falling directly onto the bog; they do not transport nutrients in runoff from adjacent areas. These wetlands are dominated by sphagnum mosses. Characteristic shrubs include Labrador tea, bog rosemary, bog blueberry, and cranberry. Stunted, gnarled shore pine, Alaska yellowcedar, western redcedar, and both hemlocks are typically scattered in these bogs. The colloquial term 'muskeg' is used to refer to the complex mosaic of fens, bogs, pools, streams, and scrubby forest that is common to the area. Bogs or muskegs are analogous to the M1 Ecological Landtype and typically include the Maybeso and Kogish soil series.

Rocky Shores

Rocky Shores are the most common type of shoreline within the Upper Carroll Creek Project Area. Terrestrial plant cover is sparse, especially on exposed rocky headlands and cliffs. Adaptations to salt spray and moisture stress include cushion and matted growth forms and thick, waxy, succulent or densely haired leaves. Sea plantain, hairy cinquefoil, coastal strawberry, chocolate lily, and salal are typical of the hardy vegetation of exposed rocky shores.

Shingle Beaches

Shingle Beaches, composed of large gravels or cobbles, are also widespread in the Project Area. They usually support clumps of searocket, dunegrass, beach pea, giant vetch, coastal strawberry, springbank clover, and sand wort. Such plants are especially common on the upper beach and among the piles of driftwood at the winter storm high tide line. Included in this ecosystem are the Salt Chuck and Sokolof soil series.

Sand Beaches

Sand Beaches are uncommon in the Upper Carroll Creek Project Area. They occur mainly as small pockets in **Rocky Shores** and **Shingle Beaches**. Vegetation is sporadic, but showy species including searocket, beach-carrot, and beach pea show up. Farther up the beaches large headed-sedge, dune grasses, paintbrushes, lupines, and silverweed become common.

Tidal Marshes

Tidal Marshes are the most productive maritime plant communities, especially those with brackish or low-salinity water, such as the relatively large estuary of the Carroll Creek delta. Soils are usually fine-textured and rich in organic matter and nutrients, supporting lush meadow vegetation. Grasses and sedges, especially tufted hairgrass, Lyngby's sedge and dune wildrye dominate, but these marshes also support silverweed, springbank clover, lupine, and giant vetch. Tidal marshes include the D1, D2, and D3 Ecological Landtypes of Babik (1995). The soils are typically Aeric Cryaquepts, coarse or fine-loamy.

Soils

The soils of Revillagigedo (Revilla) Island are the foundation upon which the ecosystem is built and functions. The soil is the interface between the biotic and abiotic components of the ecosystem, the medium in which many of the complex interrelationships characteristic of forested ecosystems take place. The soil provides the medium for plant and animal growth and is the source of the productivity which drives the ecosystem.

Soils on Revilla Island are found on a variety of terrains shaped by glaciation and characterized by U-shaped valleys with mountains extending 2,000 to 3,000 feet above sea level. Glacial till of variable thickness occurs in the valley bottoms and up to 1,500 feet on the sideslopes. Many of the valleys have numerous rocky knobs scoured by glaciation. See the Geology section of this chapter for further information.

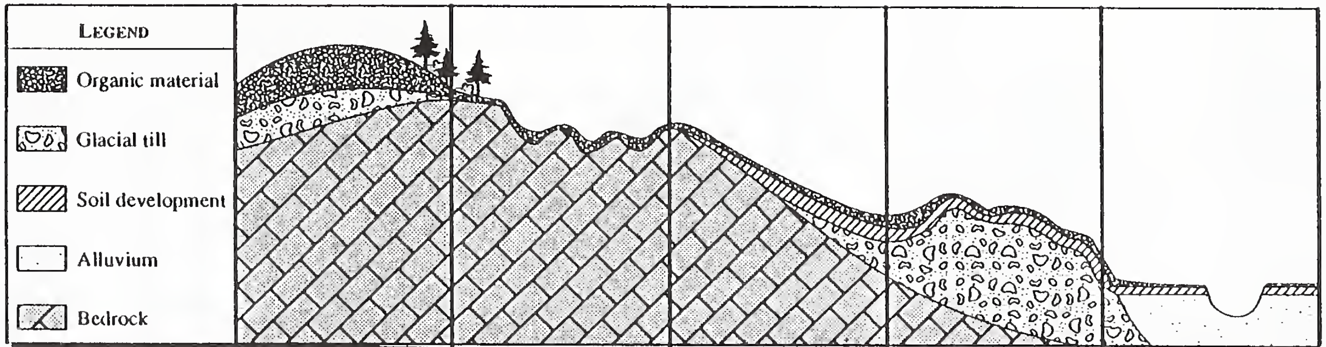
Soil development in Southeast Alaska is influenced by high levels of rainfall, cool maritime temperatures, and moderately-low annual soil temperatures. Under these conditions, organic matter decomposes slowly, resulting in a thick layer of organic material. Disturbances also play an important role in the development of Southeast Alaskan soils. Windthrow, flooding, and landslides are important types of disturbance that alter the soil surface and subsoil. In general, the other ecosystem components, parent material, topography, vegetation, animals, and climate influence the features of soils that affect and are affected by timber harvest activities. Soils influence the overall ecosystem functions, vegetation composition, water quality, riparian area, and wetland values, and the productivity of timber, fish, and wildlife in the Upper Carroll Project Area.

A soil resource inventory which identifies the soil types, their distribution, and extent, has been completed on the Upper Carroll Project Area (Soil Survey for the Ketchikan Area, USDA Forest Service, unpublished). Soil descriptions and pertinent soil references are available in the Ketchikan Area Supervisor's Office. Soil references include: the Tongass Land Management Plan (TLMP Revision, 1991a) Chapters 2 and 5; the Forest Ecosystems of Southeast Alaska (Swanston 1974); the Southeast Area Guide (USDA Forest Service 1977); the Alaska Regional Guide (USDA Forest Service 1983); and soil inventory maps and associated soil series and map unit descriptions. Additional information on riparian and wetlands soils is located in the Riparian Areas, Floodplains, and Wetlands section of Chapter 3.

Two different levels of information were used in the development of the Upper Carroll FEIS. Initially, information was derived from the Ketchikan Area Common Land Unit (CLU) inventory data. The CLU was derived primarily from the Ketchikan Area Soil Resource Inventory, a broad level resource inventory designed to be used as a Forest level planning tool. This information was used in the initial development stages of the project to define issues and the general locations of resource concerns and opportunities. It was used in the Effects Analysis of the DEIS and in Chapter 3 of the FEIS to characterize the Affected Environment for the entire Project Area.

The CLU information however, has proven to be unsuitable for some aspects of planning and implementation. This has required the supplementing of the CLU data with project level ecological landtype phase inventory information, more detailed and site specific than the CLU data, in the Upper Carroll FEIS. This information was collected over a more limited area, generally near potential harvest units and along proposed road corridors. This project inventory information is displayed on the Unit and Road Cards—Appendix K of the FEIS. This project level information has been used in the Upper Carroll FEIS to design harvest units, roads stream crossings, mitigation measures, and monitoring needs. This information is also used in the Effects Analysis in Chapter 3. Further site-specific information is available in the Upper Carroll FEIS harvest unit folders, located at the Ketchikan Ranger District office.

Figure Soils-1
Soil Characteristics



	Organic	McGilvery	Mineral	Till	Tonowek and Tuxekan
Description	Thick layer, partly to decomposed plant materials	Forest litter and partly decomposed plant material over bedrock	Shallow to deep soils developing in residuum or colluvium	Thin surface, soils developing in glacial till	Shallow to deep soils of stratified sand and gravel
Texture	Mucky peat	Peat	Sandy loam to silt loam	Sandy loam to silt loam	Sand and gravel
Soil Depth	7" to > 6'	< 8"	1' to > 6'	< 20" to < 6'	> 6'
Drainage	Poorly and very poorly drained	Well drained	Well to poorly drained	Well to poorly drained	Well to moderately well drained
Major Forest Types	Nonforest and varied forest types	Western hemlock	Western hemlock, mixed conifer	Western hemlock, Western hemlock/ yellowcedar	Sitka spruce
Landform	Ridgetops, benches, depressions, valley floor	Upper backslopes of hills and mountains	Valley floors, hillslopes, mountain sideslopes, ridgeslopes	Moraines, drumlins, and valley floor deposits	Floodplains, stream terraces
Mass Movement Index Class	Generally low	Low	Low to very high	Low to very high	Low
Timber site Productivity Class	Low to moderate	Medium to high	Medium to high	Medium to high	High
Wetland Habitat Potential	High	Low	Medium	Medium	Very high
Upland Habitat Potential	Low	Medium	High	High	Very high

Soil Properties

Long-term Soil Productivity

Soil and its productivity are critical elements since they affect the productivity of the entire forest ecosystem. Tree growth, wildlife and fish habitat, rare plant species, and subsistence plant gathering are all dependent upon the productivity of the soil. In the Project Area, timber site productivity and forage production ranges from very high on moist, well-drained floodplains, to medium and high on moderately well and well drained upland soils, to low on poorly drained soils. Site category is used as a classification of timber site productivity on the Ketchikan Area. Site Index is directly related to the height of a typical 50 year old Sitka spruce. On soils with a site index of 40, a 50 year old Sitka spruce would be 40 feet tall. On soils with a site index of 60, a 50 year old Sitka spruce would be 60 feet tall. Site categories 1 through 4 are defined as follows:

Site Category	Site Index
1	0 to 40 (low)
2	41 to 60 (medium)
3	61 to 80 (high)
4	+ 80 (very high)

The acreage by site category, within the Upper Carroll Project Area, are listed below in Table Soils-2.

Table Soils-2
Inventoried Site Category Classes in the Project Area

Low 1 Acres	Medium 2 Acres	High 3 Acres	Very High 4 Acres
13,368	8,877	8,936	14,764

SOURCE: Babik 1996

Because of the role which organic matter plays in forest productivity, maintaining the organically enriched topsoil layers is important for maintaining long-term ecosystem productivity. Soil productivity and its related nutrient content can be influenced in a number of ways by natural disturbances and timber management activities. Removal of the surface layer may be caused by windthrow, flooding, landslides, surface erosion, severe yarding disturbance, or from displacement by roads, skid trails, landings, or rock pits. Soils can also be altered by puddling, which impairs soil porosity and drainage and therefore reduces productivity. Reductions in soil productivity that last beyond the planning period are considered to be significant impairments. A 15 percent reduction in inherent soil productivity potential is the threshold for setting values for change in measurable or observable soil properties associated with long-term productivity (FSM 2554.03).

However, soil disturbance should not be considered entirely detrimental. Soil site disturbance for example, whether natural or management induced, can increase biological diversity by providing a range of site conditions which enhance the regeneration of early mid-seral stage species, such as fireweed, salmonberry, red alder, and Sitka spruce. Flood waters and landslides also deposit soil materials which develop into some of the highest productivity floodplain and footslope sites in the area.

Soil Erosion

Two major types of erosion occur within the Project Area: (1) surface erosion and (2) landslides.

Surface Erosion

Most undisturbed soils in the Project Area are resistant to surface erosion because they are generally protected by the surface layers of organic matter and the roots of vegetation. However, when mineral soils are exposed, erosion can occur. The rate of erosion depends primarily on the amount of vegetation ground cover, erodibility of the soil, and the steepness of slope. Locations where surface erosion and mass wasting are most likely are along stream banks, snowslide or avalanche slopes, and within V-notches. Timber harvest activities and road construction may increase the erosion rate by exposing mineral soil.

Landslides

Landslides are the dominant process of natural erosion in ecosystems of Southeast Alaska. Many landslides occur during or immediately after periods of heavy rainfall when soils are saturated. Landslides usually occur on steep slopes that have soils with distinct subsurface ''slip'' layers (slip-planes), such as compact glacial till or bedrock that slopes parallel to the ground surface. These areas have a high likelihood of landslides, either naturally occurring or if disturbed by blasting rock or road pioneering, side casting of excavated material, or logging practices that cause substantial surface disturbance.

Vegetation, particularly tree roots, seem to have a stabilizing effect on slopes, but tree roots tend to significantly decrease in strength five to seven years after a tree is cut (Swantson 1989). This decrease in soil holding capacity results in an increased likelihood of soil movement on steep slopes following clearcutting. Effects of partial cutting on slope stability in Southeast Alaska are relatively unknown. Under natural conditions, windthrow is an important triggering device of landslides in Southeast Alaska. Recent research in Southeast Alaska (Swanston 1989) has suggested that although less than 10 percent of all landslides in the past 20 years were related to logging or roads, logging and roads may increase the potential for landslides in a given area.

A broad analysis of soil stability conducted on the Project Area was based on the Ketchikan Area Soil Resource Inventory and CLU inventory. Landslide mass movement index (MMI) ratings were used to group soil map units that have similar properties with respect to the stability of natural slopes. Four classes of MMI, 1 (low), 2 (medium), 3 (high), and 4 (very high), have been assigned to soil map units according to their relative potential for landslides, as indicated by their physical properties.

Naturally unstable soils are common throughout the Project Area. Table Soils-3 shows total acres of each MMI class in the Project Area by VCU. These MMI ratings are based on general characteristics of typical soil map units found in the Ketchikan Area Soil Resource Inventory.

Table Soils-3
CLU Mass Movement Index Classes in the Project Area by VCU

VCU	MMI = 1 Acres	MMI = 2 Acres	MMI = 3 Acres	MMI = 4 Acres
737	2588	2345	2555	2278
744	12711	4688	4927	9886
746	2484	961	299	2267
Total	**17783**	**7994**	**7781**	**14431**

SOURCE: Babik 1996

A more detailed project level ecological landtype phase inventory of the Upper Carroll Project Area, which included potential timber harvest units and proposed roads, was conducted during project development. Maps in the Upper Carroll Planning Record display the distribution of high and very high MMI soils, mapped in this inventory, in relation to roads and harvest units. These areas are also displayed for each unit in Appendix K, Unit and Road Cards. Very high MMI soils are not suitable for timber harvest, as described in the TLMP RSDEIS (1996a), Timber Suitability Classification, pp. A1-16.

Effects of the Alternatives

Soils: Direct and Indirect Effects

Soil Productivity

The action alternatives have the potential to reduce soil productivity. However, application of soil management practices for the maintenance or improvement of soil productivity (FSH 2509.18) will limit these reductions below threshold levels (FSM 2554 R10 Supp. 2500-92-1). Furthermore, units were located and designed during the planning process to minimize adverse effects on soil productivity.

Areas of soil presently supporting productive ecosystems would be disturbed in all the proposed action alternatives to varying degrees. Disturbance of sites by road, landing, and rock pit construction will result in the loss of soil. Timber harvest may result in soil disturbance, displacement or exposure, or puddling that could reduce soil productivity. Road construction and timber harvest may result in an increase in the occurrence of landslides (Loggy 1974; Swanston 1989) and may result in reduced productivity on those sites.

Estimated amounts of soil displacement which may be expected within harvest units with the proposed silvicultural and yarding systems are displayed in Table Soils-4. In making these estimates, several assumptions were made: (1) helicopter yarding systems will result in no soil exposure, regardless of silvicultural system; (2) soil exposure with all cable yarding and silvicultural systems will result in an average of 5.9 percent of the soil surface displaced or exposed within harvest units (based upon work by Landwehr 1992); (3) shovel yarding systems will result in an average of eight percent of the soil surface displaced within harvest units (Landwehr 1992); and (4) partial cutting (single tree, group selection, see Silviculture section of this chapter) will result in the same amount of soil displacement as clearcut silvicultural systems.

Table Soils-4 displays the acres of soil disturbance that may occur with each alternative.

Table Soils-4
Soil Disturbance

	Acres of Soil Disturbance by Alternative					
	Alt. 1	**Alt. 2**	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Acres of Soil Disturbance	0	223	116	146	183	62
Total Acres Harvested	0	1,996	1,095	1,618	1,032	591
Percent of Total Harvest	0	10.2	10.6	11.3	11.7	10.5

SOURCE: Babik 1996

Soil disturbances resulting from landslides and other surface disturbances may result in long-term reduction of soil productivity. The amount of time required for rehabilitation depends on the severity of the disturbance and its exposure to continued aggravating forces.

Soil disturbance enhances the capability of some tree species, particularly Sitka spruce and western red cedar, to regenerate and grow on a site. A certain level of soil scarification is desirable on spruce and red cedar sites to prepare a suitable seedbed. In the absence of soil disturbance, regeneration conditions on most sites in Southeast Alaska typically favors western hemlock, a species that regenerates prolifically on undisturbed forest floor leaf litter.

Soil Erosion

Some soil erosion and landslides may occur in all alternatives, including the no-action alternative. Erosion will most likely occur on areas where the soil surface has been exposed.

Two forms of erosion may be accelerated by timber harvest activity:

- **Surface Erosion**—includes sheet, rill, and gully erosion on exposed mineral soils in harvest units, caused by felling and yarding activities, on road surfaces, cutbanks, and rock quarry sites.

- **Landslides**—which may be triggered by: (1) windthrow ; (2) soil disturbance through felling and yarding activities; and (3) road-building activities such as blasting, excavating slope support, overloading slopes by sidecasting excavated soil materials, and directing and accumulating water.

Surface Erosion

Some soil erosion may occur in all alternatives. Erosion will most likely occur on areas where the soil surface has been disturbed. Soil surface disturbance commonly occurs as a result of windthrow, landslides, road construction and stream channel migration. The amount of erosion that occurs will be related to the amount of soil exposure that takes place (Table Soils-4). Due to the considerable amount of ground cover remaining on areas after timber harvest, erosion rates are typically quite low. Soil productivity may be reduced and sediment production may increase for a short period of time, until the site is revegetated, typically three to five years. Since each alternative includes a different amount of timber harvest and road construction, the alternatives are expected to result in differing levels of soil erosion. Of the action alternatives, Alternative 2 will result in the greatest amount of surface erosion. Alternative 7 will result in the least amount of erosion. Alternatives 6, 5, and 3 rank second, third, and fourth in the amount of erosion taking place.

Landslides

The reserve tree forest regeneration harvest method described in the Silviculture section of Chapter 3 will help to minimize landslide potential. This silvicultural system maintains a portion of the existing stand, providing better protection of landslide prone sites by retaining a living root system.

Landslides are most likely to occur when roads are constructed on landscapes with very high mass movement indices (MMI=4). Landslides typically occur less frequently when roads are constructed or timber is harvested on areas with a lower MMI. In most cases landslides are not as common on areas with medium or low MMI.

A minor degree of soil disturbance is unavoidable under any reasonably practicable timber harvest activity. For the Project Area, 14,431 acres of the land base occur on soils inventoried as having a very high MMI. These soils are classified as unsuitable for the production of commercial timber. Timber harvest proposed on areas identified in the soil resource inventory as very high MMI required soil site inspection. During field reconnaissance, these areas were inspected by a professional soil scientist and, where appropriate, reclassified as MMI= 3 and suitable for timber harvest. Order III soil resource inventory map units typically contain inclusions of soil which may be more suitable for a particular use than the inventoried soils. Soil resource inventory data is useful for modeling effects analysis but is not of sufficient detail for use in harvest unit layout.

For analysis of the effects of the Upper Carroll Project, a more detailed ecological landtype phase inventory was conducted. Seventeen percent of the forest land base occurs on soils inventoried as having a high MMI. Units with high MMI ratings will receive special consideration by a soil scientist to apply appropriate BMPs to timber harvest units. Road construction may require geotechnical evaluation. (See Mitigation Measures, Chapter 2).

Table Soils-5 displays the amount of timber harvest that is proposed on each soil MMI class within the Project Area.

Table Soils-5
Timber Harvest by Soil Mass Movement Index Class

Soil Mass Movement Index Class	Timber Harvest in Acres					
	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Low MMI=1	0	320	150	190	146	135
Medium MMI=2	0	1,156	679	973	655	350
High MMI=3	0	520	267	455	231	107
Very High MMI=4	0	0	0	0	0	0

SOURCE: Babik 1996

Road building activities are sources of landslides and sediment. Preliminary monitoring reports of landslides initiated by road construction within the 89-94 KPC Long-term Sale EIS showed that 13 landslides occurred within a two-year period (Landwehr 1992). The total area disturbed from all 13 landslides was less than three acres. A plan that minimizes road building over potential landslide areas would lessen the possibility of landslide occurrence and associated impacts. Table Soils-6 includes miles of road construction on MMI soils for each alternative.

Table Soils-6
Road Construction by Soil Mass Movement Index Class

Soil Mass Movement Index Class	Road Construction in Miles					
	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Low MMI=1	0	23	8	19	7	0
Medium MMI=2	0	16	7	11	6	0
High MMI=3	0	19	6	10	6	0
Very High MMI=4	0	3	0	0	0	0

SOURCE: Babik 1996

Of the action alternatives, Alternative 7 proposes building the least amount of road over high MMI=3 soils, and Alternative 2 proposes to build the most over these soil types. There is a low potential for measurable impacts to water quality and fish habitat from management-induced landslides if any of the action alternatives are implemented. The results of a recently completed Tongass-wide landslide survey can help illustrate the potential for landslide impacts in the Upper Carroll Project Area (Swanston and Marion 1991). This regional landslide survey, which included only large landslides greater than 100 cubic yards of soil displacement, estimates a landslide rate of 1.7 slides over a 20-year period. However, these results also indicate that a relatively small percentage of sediment generated from large landslide events will reach a stream. Swanston (1989) estimated that the increase in the incidence of landslides over natural occurrences throughout Southeast Alaska was about 3.5 times greater on managed acres.

Swanston's Tongass landslide survey categorized 23 percent of all landslides as debris torrents that occur in deeply cut V-notch gullies. Long-term impacts (greater than 10 years) to channel form and function and to fish habitat would be anticipated for Class I channel segments directly affected by a large landslide (Hogan and Wilford 1989). Based on Swanston's results, there is about a one-in-four chance that any management-related landslide will have an impact on Class I streams and only a very slight chance that impacts on fish habitat could occur. It can be inferred that the majority of these landslides would affect primarily Class III stream channels, since only about 3 percent of all natural and management-induced slide events in this survey were shown to directly affect Class I streams.

Care should be taken in extrapolating these results to the Project Area. Road construction and harvesting technology changes, as well as greater sensitivity to water quality and fish habitat concerns (as reflected in BMPs, for example, and much improved soil and water inventory information), have resulted in more effective management practices for timber operations in landslide prone areas. These factors will tend to reduce management-related landslide incidences in the Project Area from the rate observed by Swanston. On the other hand, many of the areas included in Swanston's survey had road systems that were predominantly located on stable locations on lower valley slopes. Roaded segments in the Project Area are proposed on relatively steep slopes, a factor which would tend to increase the potential incidence of road-related landslides. Thus, the frequency of landslide occurrence in the area is difficult to predict; however, areas with a high potential for landslide occurrence were evaluated in the planning process, and timber harvest was deferred in many of these areas during unit design.

Some of the roads proposed in this project are located on steep slopes which require special construction techniques to minimize the potential for slope failure. One of the techniques commonly used on these steep slopes is the excavation and full bench construction of roads. Full bench road construction generates large quantities of waste rock and overburden, material which typically cannot be disposed of on these steep slopes. This material must be hauled away and disposed of at a suitable site. Wetlands, riparian areas, or soils with a high risk of slope failure are not suitable disposal sites.

Alternative 2 would have the greatest direct effect in 1997. Alternative 7 would result in the least amount of soil disturbance. Alternatives 3, 5, and 6, respectively, would result in increasing amounts of soil disturbance. In all instances, the actions proposed would minimize soil disturbance to the maximum extent practicable through implementing the BMPs in the Soil and Water Conservation Handbook (FSH 2509.22).

The existing condition (1995) shows construction of about 10.1 miles of roads in the Project Area, resulting in a loss of about 90 acres of soil in road right-of-way and rock quarry development since 1954. Approximately 110 acres of soil surface are estimated to have been exposed by timber harvest activity in the Project Area. Alternative 1 would maintain this existing condition through the year 2004.

Alternative 2 would result in a total of about 78 miles of road construction and rock quarry development, resulting in about 700 acres of soil disturbance by 2004. It is estimated that Alternative 3 would result in a total of about 320 acres lost to road construction and quarry development and about 112 acres of soil disturbed within harvest units. Implementation of Alternative 5 results in about 400 acres of road construction and rock quarry development and 146 acres of exposed soil surface by 2004. Alternative 6 produces about 510 acres of roads and quarries and 183 acres of disturbed soil by 2004. Alternative 7 would result in 0 acres lost to road construction and quarry development and about 46 acres of soil disturbed within harvest units.

Soils: Cumulative Effects

TLMP RSDEIS (1996a) analysis forecasts that by 2140, all suitable lands within the Project Area (approximately 8,000 acres) will consist of a mosaic of even-aged stands of varying age classes and all-aged stands, the product of even-aged silvicultural systems. These management activities will incorporate state-of-the-art soil conservation practices as they are implemented. By maintaining soil productivity in the upcoming decades, the cumulative effects of these actions will remain within soil productivity threshold levels.

Cumulative effects of these actions upon long-term soil productivity are directly related to the amount of soil disturbance that occurs through time and the amount of recovery that takes place in the soil system during this time. The soil is a complex system with the capacity to absorb and recover from many of the impacts resulting from management of this nature.

Swan-Tyee Transmission Line

Cumulative effects to soils considers the impacts of other projects in the Upper Carroll Project Area. This includes the Swan Lake-Lake Tyee Intertie project, currently being addressed in a separate EIS. The proposed action for the Swan Lake-Lake Tyee project features the clearing of a transmission line corridor and 75-foot-wide road right-of-way. The total amount of expected soil disturbance within the Upper Carroll Project Area amounts to about 19 acres. Combined with rapid revegetation, this dispersed acreage would have virtually no effect on soil productivity or on sediment delivery to streams except in case of a landslide.

If a service/access road were to be constructed as part of the Swan Lake-Lake Tyee project, it would cross about 52 acres of high and very high landslide potential soils. If this road were not properly built, this could produce locally serious landslide problems. Mitigation measures applied during road design and construction are necessary in the Carroll and Neets Creek drainages to maintain slope stability.

Riparian Areas, Floodplains, and Wetlands

Key Terms

Bog—a wetland of slow-moving, nutrient poor, highly acidic water formed of peat derived predominantly from sphagnum moss.
Ecosystem—a complete, interacting system of organisms together with their environment (for example a bog, forest, or lake).
Estuarine—deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land, but which have open, partly obstructed or sporadic access to the open ocean, and in which ocean water is diluted by freshwater runoff.
Fen—a wetland of slow-moving, nutrient rich, often alkaline water with sedge peat forming the substrate.
Hydrophytic vegetation—plants typically found in wetlands and dependent upon wetland moisture regimes for growth and reproduction.
Muskeg—a type of bog that has developed in depressions or flat areas, poorly drained acidic, with organic soils that support vegetation that is predominantly sphagnum mosses and heaths.
Primary succession—vegetation development that is initiated on surface exposed for the first time, which has never supported vegetation before.
Riparian area—the area including a stream channel, lake or estuary bed, the water itself, and the plants that grow in and on the land next to the water.
Riparian ecosystem—land next to water where plants that are dependent upon a perpetual source of water grow.
Riparian management area—the area including water, land, and plants that is at least 100 slope feet away from each side of perennial streams, lakes, and other bodies of water.
Secondary succession—the process of reestablishing vegetation after normal succession is disrupted by fire, cultivation, timber harvest, windthrow, or any similar disturbance.
Wetlands—areas that are inundated by surface or ground water with a frequency sufficient, under normal circumstances, to support vegetation that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Affected Environment

Riparian areas are geographically delineable areas with distinctive resource values and characteristics that are comprised of the aquatic and riparian ecosystems. These riparian areas are characterized by deep, well drained alluvial soils supporting a range of seral plant associations, including Sitka spruce/devil's club-salmonberry, Sitka spruce/blueberry/skunk cabbage, red alder/salmonberry-stink current, Sitka willow and beach ryegrass-hairgrass/silverweed. The soils are mostly the Tonowek soil series, with lesser amounts of the Tuxekan series. Also included are significant areas of silty or gravelly alluvium along overflow channels, on point bars, and in tidal flats. This is the Riparian Habitat Landscape Management Zone described in Chapter 2, Table 2-1.

Riparian areas are located throughout the study area, with large areas along the lower reaches of Carroll and Neets Creeks. Riparian areas are located along all streams within the Project Area, from major AHMU Class I streams to smallest Class III streams. The riparian area may range from 1,500 feet wide in the lower reaches of Carroll Creek to only a couple of feet along the smaller, high gradient, contained stream channels.

For further information on riparian areas see the *Upper Carroll Soils and Associated Ecosystem Resource Report*, 1994.

Riparian Areas

Riparian areas include stream or lake systems and the adjacent land. A riparian ecosystem is identified in part by soil characteristics or distinctive plant communities that require free or unbound water (FSM 2526.05).

Within the Project Area, riparian areas include perennial streams, bodies of water with actively flowing freshwater, bodies of freshwater which fish inhabit, and estuaries (see description in Chapter 3, Fisheries, Affected Environment). Also included are the lands immediately adjacent to and associated with these areas which are dominated by riparian vegetation or provide water quality protection.

About 3.4 percent of all existing riparian areas within the Project Area have been harvested between 1954 and 1990. Most of this timber harvest occurred in the Carroll Creek watershed, with approximately 86 acres of riparian area cut. About 30 acres of riparian areas within the Neets Creek watershed have also been harvested.

Riparian areas previously harvested for timber are now in various stages of secondary plant succession. Except where the ground is highly disturbed, the stand composition on the secondary successional riparian area is similar to riparian vegetation prior to timber harvest, with Sitka spruce typically forming the canopy. On the more disturbed sites where mineral soil was exposed during timber harvest activities, the vegetation is often composed of early successional species, such as red alder and salmonberry.

Floodplains

Floodplains are composed of naturally eroded sediments carried by the stream or river and deposited in slack water sections of channels during high water periods. Floodplains are considered to be areas subject to a 1 percent (100-year recurrence) or greater chance of flooding in any given year. Nutrient-rich sediments underlain by coarse textured sediments make floodplains the most productive lowland timber, wildlife, and fisheries resource sites on the Tongass.

Two major floodplains are located within the Upper Carroll Project Area. The principal floodplain is located along the lower reaches of Carroll Creek. Floodplains are defined in FSM 2527.05. This floodplain is over 2 miles long and ranges up to 1,500 feet in width. It contains a well defined main channel, a number of overflow and side channels, and extensive areas of beaver influenced ponds. Floodwater flows in the lower reaches of the river have been altered by the construction of Forest Development Road No. 8400. Some timber has been harvested in this floodplain in the past. A 100-year precipitation event will inundate most of this area. Smaller areas of floodplains are located in the upper part of the Carroll Creek system.

The second major floodplain is along Neets Creek, below and above Bluff Lake. This floodplain is over 2 miles long and averages about 200 to 300 feet wide. Floodwaters in this system are influenced by two significant lacustrine areas, Bluff and Neets Lakes. These water bodies tend to contain and moderate floodwaters. Past road construction and extensive timber harvest in this floodplain have affected floodwater flows by blocking overflow channels with roads and logging debris and altering channels by borrowing gravel and developing stream crossings. The management of water in the Neets Creek system by the Southern Southeast Regional Aquaculture Association (SSRAA) has influenced floodwaters in the system. Floodwaters have also been influenced by the damning of Bluff Lake, raising the lake level by several feet, increasing storage capacity, and diverting of lake water to the SSRAA fish hatchery in the lower valley. There is an estimated 1,444 acres of these floodplains within the Upper Carroll Project Area.

Table Riparian-1 displays the floodplain acres by watershed within the Project Area.

Table Riparian-1
Acres of Floodplains

Watershed	Floodplain
Carroll Creek	1,241
Neets Creek	115
North Saddle Lakes	88
Total	1,444

SOURCE: Babik, 1996

Wetlands

Wetlands are defined as: "those areas that are inundated or saturated by surface or groundwater with a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions" (40CFR 230.41(a)(1). Identification of wetlands is based on the Corps of Engineers three-parameter system described in U.S. Army Corps of Engineers Wetlands Delineation Manual (COE 1987). Wetlands are identified as areas having hydric soils, hydrophytic vegetation, and wetland hydrology. Soil resource inventory maps, including correlations between soil series and plant communities, were used to determine the extent of wetlands in the Upper Carroll Project Area. Hydrologic parameters were inferred from the soil moisture regime.

Using this wetland definition and delineation method, approximately 43 percent (22,647 acres) of the Upper Carroll study area is classified as wetland. These extensive wetlands within the Upper Carroll area, however, are not all alike but consist of at least 15 different types of wetlands. Each wetland type has different soil and vegetative communities, occupy different landscape positions, and have somewhat different functions and values. The majority of these wetlands are palustrine open or palustrine forested. The most common wetland type is the Forested Wetland/Forested Non-Wetland Complex. Most of the lacustrine wetlands are located in the Neets Creek valley. Areas of riverine wetlands are located mainly along Neets and Carroll Creek. A significant area, about 22 acres, of estuarine wetlands is located where Carroll Creek discharges into Carroll Inlet.

The biological significance of a wetland is related to the value of its functions and, at least in part, to the relative scarcity of the wetland type in the landscape. This is especially true in terms of biological diversity on the landscape scale. The relatively scarce fens and estuarine salt marshes in the Upper Carroll area have a greater biological significance than the more common bogs and forested wetlands which are widespread throughout the landscape.

Value and Function

Wetland values are defined here as socio-economic benefits derived from wetlands functions. Values include: wildlife viewing and harvest, commercial fishing (salmon habitat provided by estuaries, streams, and lakes), development sites (for example, buildings and roads), community water supplies, actual and potential recreation, and timber harvesting. Functions are ecosystem attributes and can be organized as follows:

- Physical functions: flood conveyance, coastal erosion barriers, water retention and regulation, heat absorption, and sediment collection.
- Chemical functions: acidic water pH levels, high tannins, and ability to accumulate significant carbon and nutrients (nitrogen).
- Biological functions: wetlands in Southeast Alaska produce timber (generally in lower volume classes), provide habitat for fish (notably salmon) and wildlife (notably waterfowl and bears), and provide smaller animals as part of the food web. Wetlands feature high plant and animal diversity.

Wetland Types

Wetland types within the Project Area include:

Alpine Dwarf Evergreen/Alpine Shrub Complex

The vegetation is composed of heaths; crowberry, mountain heather, etc., and dwarf shrubs; willow, blueberry on shallow, poorly drained organic soils. It is included within the AF6 ecological landtype (Babik, 1995). This wetland is included within the palustrine scrub-shrub wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands function mainly as areas of snow storage and meltwater discharge, as summer habitat for terrestrial wildlife, particularly Sitka black-tail deer, and on the east side of the Project Area, mountain goats. This wetland type makes up about 3,125 acres of the Project Area. These wetlands are common on the Mount Reid ridgeline along the eastern edge of the Project Area.

Alpine Shrubland/Emergent Muskeg

Alpine wetland plant communities occur on poorly drained organic soils. This wetland type is a combination of palustrine emergent wetland and palustrine scrub-shrub wetland. It is included within the AF6 ecological landtype as described by Babik, 1995. These wetlands function mainly as areas of snow storage and meltwater discharge and summer habitat for terrestrial wildlife species.

There is about 4,172 acres of this wetland type in the Project Area. These wetlands are common throughout the Project Area at elevations of above 2,500 feet.

Emergent Tall Sedge Muskeg/Alpine Shrubland

A combination of sedge meadow fens on deep peat deposits in depressions and low growing blueberry and mountain heather heaths on higher rises. The soils are typically shallow, poorly drained peats and mineral soils. This wetland type is included within the AF6 ecological landtype (Babik, 1995) and the palustrine emergent wetland and palustrine scrub-shrub wetland of the U.S. Fish and Wildlife Service wetland classification system. The functions that these wetlands serve includes storage of winter snowpack, recharge of downslope streams and aquifers, and summer season wildlife habitat. These wetlands are relatively scarce within the Project Area, comprising about 205 acres. These high elevation sedge meadows provide unique summer range grazing opportunities for black-tailed deer, black bears, and where they occur, mountain goats. They occur in small patches, generally less than one or two acres, and are located around the edges of alpine lakes and in wet alpine meadows scattered throughout the Project Area.

Alpine Shrubland/Non-Wetland Non-Forest Complex

This wetland type is included within the AF6 ecological landtype (Babik, 1995). This wetland is also included within the palustrine scrub-shrub wetland of the U.S. Fish and Wildlife Service wetland classification system. The functions that these wetlands serve include storage of winter snowpack, recharge of downslope streams and aquifers, and summer season habitat for upland wildlife. About 251 acres of this wetland type occur in the Project Area.

Alder/Salmonberry Shrublands on Mountainslopes

This wetland type is found on steep avalanche tracts which support stands of predominantly Sitka alder-salmonberry and elderberry. These wetlands are made up mainly of poorly drained, poorly developed mineral soils. This wetland type is included within the B ecological landtype (Babik, 1995). This wetland is included within the palustrine scrub-shrub wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands function as areas of snow storage, groundwater and stream recharge, and terrestrial wildlife habitat. These wetlands are important foraging areas for black-tailed deer and black bears. Two thousand four hundred and forty-eight acres of the area are made up of this wetland type. These wetlands are located mostly in the heads of the valleys which drain the Mount Reid ridgeline.

Estuarine Emergent

This wetland type supports mainly sedge and beach ryegrass communities. The soils are poorly drained silts, sands, and gravels. It is similar to the D3 ecological landtype (Babik, 1995). This wetland is included within the estuarine-intertidal wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands are among the most unique, valuable, and scarce in the Project Area. They function as areas of flood conveyance, tidal/freshwater mixing zone, shoreline protection, dilution of chemicals and pollutants, and deposition of sediment and nutrient storage. They are very valuable to shorebird, waterfowl, aquatic, marine, and terrestrial wildlife habitat, including important foraging habitat for black bear (possibly brown bear), mink, and river otter. They are probably the most biologically diverse sites within the Project Area. They are important sources of faunal and floral diversity. Along the inland edges of the Carroll Creek estuary grow the largest stands of Sitka willow (*Salix sitchensis*) on the island. This is probably the most important area for subsistence use in the Carroll Creek drainage. Twenty-two acres of this wetland type are in the Project Area, mainly at the outlet of Carroll Creek.

Emergent Short Sedge Muskeg

This is one of the relatively rare wetland types within the Project Area. This wetland includes fen communities dominated by short sedges. The soils are typically deep, poorly drained peats and mucks. It is included within the M2 ecological landtype (Babik, 1995). These wetlands are included within the palustrine emergent wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands convey ground and surface waterflows along the landscape hydraulic gradient from higher parts of the landscape to riparian and lacustrine areas at the lower end of the gradient. These wetlands function as among the most valuable areas for recharge of groundwater and streams and deposition and storage of sediment, nutrients, and other chemicals. They provide unique waterfowl habitat, particularly for Vancouver Canada geese and sandhill cranes. They serve as terrestrial wildlife habitat for black bear, mink, river otter, pine martin, and beaver. This wetland type makes up about 155 acres of the area. This wetland type is included within the Riparian Fens Landscape Management Zone described in Chapter 2, Table 2-1.

Forested Wetland/Emergent Sedge Complex

These wetlands are a complex of mixed conifer plant series and sedge meadow fens on poorly drained peat soils. These wetlands are included within the palustrine forested wetland and palustrine emergent wetland of the U.S. Fish and Wildlife Service wetland classification system. This is one of the relatively rare wetland types within the Project Area. These wetlands function as among the most valuable areas for recharge of groundwater and streams; deposition and storage of sediment, nutrients, and other chemicals; waterfowl habitat, particularly Vancouver Canada geese and sandhill cranes; terrestrial wildlife habitat, including black bear, river otter, mink, and beaver foraging. There are 99 acres of this wetland type in the Project Area. This wetland type is included within the Riparian Fens Landscape Management Zone described in Chapter 2, Table 2-1.

Forest Wetland/Forested Non-Wetland Complex

These areas consist of a mixture of wetlands and non-wetlands in a complex mosaic of micro-topography that controls drainage and water regimes. This wetland type is similar to the MF5 ecological landtype described by Babik, 1995. The wetland component is included within the palustrine forested wetland of the U.S. Fish and Wildlife Service wetland classification system. The wetland component typically supports a mixed-conifer/blueberry/skunk cabbage or related plant association. The soils are usually deep, poorly drained mucks and peats. These wetlands function as areas for recharge of groundwater and streams, and deposition and storage of sediment, nutrients, and other chemicals. This wetland type makes up about 4,394 acres of the Upper Carroll Project Area.

Forested Wetland

This wetland type includes forested wetland plant associations, including those with skunk cabbage and deer cabbage as a major ground cover component. This wetland type is similar to the F5 ecological landtype described by Babik, 1995. This wetland is included within the palustrine forested wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands function as areas for recharge of groundwater and streams, and deposition and storage of sediment, nutrients and other chemicals. It makes up about 3,061 acres of the Project Area. These wetlands are located on mostly lower side slopes and footslopes scattered throughout the Project Area.

Lakes and Ponds

Open freshwater systems. These are the lacustrine wetlands. These areas function as important habitat for most aquatic species, including coho salmon and cutthroat trout, as well as functioning as flood control, discharge to streams, sediment and nutrient storage, and habitat for river otter, beaver, and waterfowl. The Project Area contains about 365 acres of lakes and ponds. The major lakes, Neets and Bluff Lakes, are located in the Neets Creek valley.

Sphagnum Peat Muskeg

These are bogs characterized by deep, very-poorly drained accumulations of sphagnum moss. This is the M1 ecological landtype (Babik, 1995). This wetland is included within the palustrine emergent wetland of the U.S. Fish and Wildlife Service wetland classification system. These wetlands function as areas for recharge of groundwater and streams, and deposition and storage of sediment, nutrients, and other chemicals. These wetland are relatively rare and unique within the Project Area. They are a valuable source of biological diversity, supporting a number of unique and some locally rare plant species. There are about 61 acres of this wetland type in the Area. The largest areas of this wetland are located in the upper Carroll Creek valley.

Emergent Tall Sedge Fen

These wetlands include fen communities dominated by tall sedges, typically Sitka sedge *(Carex sitchensis)*. The soils are typically deep, very poorly drained peats or alluvial sediments. These wetlands are similar to the M3 ecological landtype (Babik, 1995). This wetland is included within the palustrine emergent wetland of the U.S. Fish and Wildlife Service wetland classification system. These fens occupy an intermediate landscape position and serve as the hydraulic connection between those bogs and other wetlands on higher landscape positions which donate waters to the riparian, lacustrine, and estuarine wetlands at the lower end of the landscape hydraulic gradient. They function as among the most valuable areas for recharge of groundwater and important fish streams; deposition and storage of sediment, nutrients and other chemicals; waterfowl habitat, particularly Vancouver Canada geese and sandhill cranes; terrestrial wildlife habitat, including black bear (rarely brown bear), mink, river otter, and beaver foraging. They are relatively scarce. Only 214 acres of this wetland type are found in the Project Area. These wetlands are located mainly around the margins of beaver influenced ponds, other lacustrine wetlands and riparian areas. The location of these wetlands, adjacent to many of the areas important fish streams, make them especially unique and important areas for stream recharge and trapping of sediment. Areas of these wetlands are located in the Neets Creek valley, above Bluff Lake, in the lower part of the Carroll Creek valley, just north of the first major tributary from the east, and in the upper Carroll Creek, along the upper western fork. This wetland type is included within the Riparian Fens Landscape Management Zone described in Chapter 2, Table 2-1.

Scrub-Shrub Evergreen/Muskeg

This wetland supports bog and bog-shrub vegetation, Labrador-tea, bog laurel, and blueberry are common. When conifers are present, they are typically less than 25 feet high. The soils are typically deep, poorly drained peats. These wetlands function as areas for recharge of groundwater and streams, and deposition and storage of sediment, nutrients, and other chemicals. They are similar to the MF5 ecological landtype (Babik, 1995). This wetland is included within the palustrine scrub-shrub and palustrine emergent wetlands of the U.S. Fish and Wildlife Service wetland classification system. About 331 acres of the area is made up of this wetland type.

Forested Scrub-Shrub Evergreen/Emergent Sedge Complex

These wetlands consist of a combination of forested wetlands and sedge meadow bogs. They are palustrine forested and palustrine emergent wetlands in the U.S. Fish and Wildlife Service wetland classification system. These wetlands function as areas for recharge of groundwater and streams, and deposition and storage of sediment, nutrients and other chemicals. They are similar to the MF5 ecological landtype (Babik, 1995). About 3,981 acres of this wetland type are included within the Upper Carroll Project Area. One variation of this wetland type occurs along the major streams and includes the Sitka spruce/devil's club/skunk cabbage, red-alder/stink current, and Sitka willow plant associations. These riparian wetlands are among the most valuable wildlife habitats in the area, providing foraging, nesting, and denning sites for most of the terrestrial and avian species present. Parts of this wetland type are included within the Riparian Fens Landscape Management Zone described in Chapter 2, Table 2-1.

For further information on wetlands and wetland habitats see the *Upper Carroll Soils and Associated Ecosystem Resource Report*, 1994.

Estuaries are discussed in more detail in the Fisheries section of this chapter. For defining wetlands the Forest Service uses the Corps of Engineers three-parameter (soil, hydrology, and vegetation) method. Wetland types were generated using soil resource inventory maps, based on correlations between soil series and plant associations. Hydrologic parameters were inferred from the soil (soil moisture regime) and vegetation (hydrophytic index) parameters (DeMeo and Loggy, Forest Service Report, unpublished).

Two different levels of information were used in the development of the Upper Carroll FEIS. Initially information on wetlands was derived from the Ketchikan Area Common Land Unit (CLU) inventory data. The CLU was derived primarily from the Ketchikan Area Soil Resource Inventory, a broad level resource inventory designed to be used as a Forest level planning tool. This information was used in the initial development stages of the project to define wetland issues and the general location of wetlands. It was used in the DEIS Effects Analysis and is used in Chapter 3 of the FEIS to describe the wetlands Affected Environment.

The CLU information however, has proven to be unsuitable for some aspects of planning and implementation. It's general nature and lack of detail results in erroneous and misleading assumptions being made at the project level. This has required the supplementation of the CLU data with project ecological landtype phase inventory information, more detailed and site-specific than the CLU data, in the Upper Carroll FEIS. This information was collected over a more limited area, generally including potential timber harvest units and along proposed road corridors. This project level information for wetlands is displayed on the Unit and Road Cards, Appendix K of the FEIS. This project level information is used in the Effects Analysis in Chapter 3. Further site-specific information on wetlands is available in the Upper Carroll FEIS harvest unit folders, located at the Ketchikan Ranger District office.

The natural and beneficial values of each wetland type differ in terms of their benefit to wildlife habitat, fish habitat, hydrologic properties (flood flow moderation, groundwater recharge and discharge), site productivity, and water quality.

Skunk cabbage is a common indicator of local wetlands.

The total area of selected wetland types within the Project Area is shown in Table Riparian-2. A wetlands map of the Project Area can be found in the Planning Record.

Table Riparian-2
Acres of Selected Wetland Types Within the Project Area

Forested Wetland	Estuarine Emergent Wetland	Forested Wetland/Forested Non-wetland	Sphagnum Peat Muskeg	Forested Scrub-Shrub Evergreen/Emergent Sedge
3,061	22	4,394	61	3,981

SOURCE: Babik 1995

Effects of the Alternatives

Direct and Indirect Effects

Riparian Areas and Floodplains

Executive Order 11988 directs Federal agencies to provide leadership and take action on Federal lands to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains. Agencies are required to: (1) avoid the direct or indirect support of floodplain development whenever there are practicable alternatives, (2) evaluate the potential effects of and proposed action on floodplains, (3) ensure that planning programs and budget requests consider flood hazards and floodplain management, and (4) prescribe procedures to implement the policies and requirements of the Executive Order.

Many of the riparian areas and floodplains in the Project Area have been affected since the 1950s. Road construction and timber harvest in riparian areas in Neets Creek valleys during the 1950s and 1960s has affected about 30 acres. The lower reaches of the Carroll Creek floodplain and its tributaries have also been affected, with about 86 acres of timber harvest having occurred. Impacts have included disturbance of riparian soils and initiation of primary successions, resulting in replacement of spruce stands with even-aged stands of red alder.

Table Riparian-3 shows the area within each watershed that has been proposed for inclusion within timber harvest units.

Table Riparian-3
Proposed Timber Harvest in Riparian Areas (Acres)

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Carroll Creek	0	3.5	3.6	3.6	2.6	2.5
Neets Creek	0	0	0	0	0	0
North Saddle Lakes	0	0	0	0	0	0
Total	**0**	**3.5**	**3.6**	**3.6**	**2.6**	**2.5**

SOURCE: Babik 1996

Effects of the proposed harvest levels upon riparian management areas will be minimal. Adherence to Forest Plan harvest control prescriptions for Riparian Habitat Land Use Designation, along with monitoring (see Chapter 2), will ensure that riparian values are maintained.

During road construction, both direct and indirect impacts to riparian areas and floodplains may occur. There may be no detectable influence, or there can be flow alteration in minor streams because of routing by roadside ditches and culverts. Channel and flow alteration may locally affect the velocity of flows, width, and depth of water, and the location of flow. Such factors may physically result in different erosion and sediment transport characteristics.

Table Riparian-4 summarizes the number of roads that cross streams and that may affect riparian areas. All proposed new road construction is included.

Table Riparian-4
Number of Road Crossings in Riparian Areas

Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
0	167	94	86	75	12

SOURCE: Oien 1996

BMPs will be used to minimize impacts on floodplains as well as to protect roads and drainage structures. Examples of such practices include designing bridges and culverts to handle the expected flows and installing frequent cross drains or ditch-relief culverts to minimize erosion from large concentrations of water moving overland or where they center natural drainages.

Additional information on riparian area management is described in the Riparian Management Strategy, Water Resource section of Chapter 3.

Wetlands

Several forested and nonforested wetland types occur in the Project Area. These have been placed in fifteen wetland types, as described in the Affected Environment portion of this section. Wetlands have value as habitat to a variety of wildlife species, some of which use wetlands seasonally or as travel ways. Other wetland values which may be affected by the proposed alternatives include value as timber sites, water supply, and flood control.

Executive Order 11990, as amended, requires Federal agencies exercising statutory authority and leadership over Federal lands to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands. Federal agencies are required to preserve and enhance the natural and beneficial values of wetlands in carrying out their responsibility for: (1) acquiring, managing, and disposing of lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use.

Forest managers are required to consider alternative road locations and effects on wetlands. Roads are located outside of estuarine, lacustrine, and riverine wetlands, to the maximum extent possible, to maintain their function; see Table Riparian-5, Road Construction and Timber Harvest on Wetlands by Alternative. When it is necessary to cross wetlands, appropriate BMPs and mitigation measures are incorporated into road designs. Constructing roads on muskegs and forested wetlands requires rock overlay construction techniques which maintain the physical, chemical, and biological functions of the wetlands. Road construction does cover wetland vegetation with rock, and may result in local changes in wetland vegetation.

Effects will be minimized by not using wetlands for overburden disposal whenever possible and by minimizing road clearing limits. The interruption of subsurface drainage by making wetlands either wetter or dryer affects long-term site productivity. Detrimental altered wetness, identified when an area becomes perennially flooded or drained and the effective function or value of the wetland is lost, will be limited to those areas beneath and within a few feet of the road. Detrimental altered wetness will occur on less than one half of a percent of Project Area wetlands, a range of about nine acres (Alternative 3) to 53 acres (Alternative 2), well within Regional standards for detrimentally altered wetness (FSH 2554 R-10 Supplement 2500-92-1). When possible, alternate locations on adjacent uplands are used.

Wetland vegetation will be affected by road construction. Preliminary monitoring results by Babik on the adjacent North Revilla Project Area and in the Shoal Cove vicinity indicate that road runoff may affect wetland vegetation composition. Sediment transported in road runoff and fugitive dust appear to add nutrients to roadside sites, lowering acidity and increasing fertility. These chemical changes are particularly apparent in the sphagnum peat muskeg and scrub-shrub evergreen/muskeg wetland types. A change in species composition from acid-tolerant bog vegetation to a more eutrophic, sedge-meadow fen type typically takes place within several meters of the road. Wetland moisture regimes change very little as a result of road construction. Groundwater flow through the typical wetland peat and muck is very slow. Slow ground water flow combined with high precipitation result no significant drainage when peatlands are ditched. Effects of drainage are usually noticeable within only a meter or two of roadside ditches.

BMPs designed to minimize effects upon water quality also serve to minimize the effects of timber harvest and road construction upon wetlands. Full suspension of logs and other low impact yarding systems minimize disturbance of wetland vegetation and surface waterflow. Timber harvest is expected to have minimal long-term effects upon the physical, chemical, and biological functions of wetlands.

The most biologically valuable wetlands—estuarine, lacustrine, and riverine—will be minimally affected by this proposed action. Transportation facilities and timber harvest units are designed to minimize the effects upon these valuable wetlands. BMPs and mitigation measures are applied to protect wetland resources (see Chapter 2 and the Unit Card appendix). Wildlife habitat values of forested wetlands may be affected by timber harvest by altering the forest structure. These effects are discussed in Chapter 3.

Approximately 43 percent (22,647 acres) of the Project Area are classified as wetland. At the present time, an estimated 13.5 percent (3,061) of these forested wetlands support commercial forest stands. Many of the wetlands on the Project Area do not support commercial or economic stands of timber and are not scheduled for harvest in this or future plans. Larger muskegs supporting no commercial timber will not be harvested, but may be affected by yarding operations within the unit. Table Riparian-5 presents data on proposed harvest on wetlands by alternative. Of the action alternatives, Alternative 7 harvests the least amount of forested wetlands, while Alternative 2 harvests the most acres. Alternatives 5, 6, and 3 rank second, third, and fourth in terms of most acres of forested wetlands proposed for harvest.

Timber harvest on forested wetlands involves manipulation of the vegetation, which temporarily changes the hydrology of the site. Patric (1966) suggests an increase in water yield may result from timber harvest. A temporary increase in soil moisture is expected until vegetation is established.

Timber site productivity on wetland soils is typically lower than on better drained soils. Growth rates on wetland sites are expected to be slower than non-wetland sites, and rotation lengths may be slightly longer than 100 years. Areas where slow growth is expected range from 17 to 55 percent of the total timber harvest, depending on alternative (Table Riparian-5).

Table Riparian-5
Road Construction and Timber Harvest Activity on Wetlands by Alternative*

Watershed	Carroll Creek	Neets Creek	North Saddle Lakes	Total
Alternative 1				
Road Miles	0	0	0	0
Timber Harvest Acres	0	0	0	0
Alternative 2				
Road Miles	27.0	4.3	2.8	34.1
Timber Harvest Acres	106	66	59	231
Alternative 3				
Road Miles	5.5	0.0	2.9	8.4
Timber Harvest Acres	26	0	40	66
Alternative 5				
Road Miles	14.2	0.0	2.9	17.2
Timber Harvest Acres	52	0	67	119
Alternative 6				
Road Miles	6.1	0.5	0	6.6
Timber Harvest Acres	39	0	37	76
Alternative 7				
Road Miles	0	0	0	0
Timber Harvest Acres	26	0	37	63

SOURCE: Babik 1996

* Most of the proposed timber harvest occurs on the forested wetland type; small areas of other wetland types may be included in some harvest units. Road construction may occur on all wetland types. Data for proposed roads and units on wetlands were derived using the Ketchikan Area GIS data base.

New road construction on wetlands will be limited to the needed transportation components of roads, landings, and drainage structures. BMPs will be used, especially with regard to the use of wetlands as filter strips to capture sediment. Ditch construction will be minimized on open muskegs to the extent consistent with minimizing water accumulations on the road surface and sediment production. Roads through wetlands can affect the flow of water in the wetland. Placement of culverts and other road drainage features will ensure that flow and reach of water in the wetland are maintained at a natural level. Impacts from roads will be limited to the wetland directly underlying the road prism and associated cuts and fills.

Rock overlay construction on wetlands covers the vegetation, but provides a highly permeable fill that minimizes changes in hydrologic conditions. No changes in chemical conditions are anticipated.

Application of BMPs during construction will assure that waterflows, circulation patterns, and chemical and biological characteristics of the water within wetlands will not be impaired. Additionally, use of BMPs will assure that adverse impacts to the aquatic environment will be minimized. In terms of terrestrial environment, wildlife use of wetlands for travel ways and predation may be reduced during periods of vehicular traffic on the roads.

Indirect Effects of Timber Harvest on Wetlands

The indirect effects of road building and logging of forested wetlands within watersheds over time are another concern. The assumptions described below will be used to assess these effects.

Assumptions

- Suitable timber base will remain the same. All analysis will be based on the operable timber within the VCU.
- Standards and guidelines for harvest and road construction activities will remain constant over the remaining contract period.
- Future accessibility of timber in relation to wetlands will be similar to the accessibility encountered in this sale.
- Distribution of wetlands is similar in all VCUs.

Prior to 1995, approximately 1,391 acres of timber were harvested in the Project Area. Approximately 385 of those acres (28 percent), are forested wetlands. During this operating period (1995-2004), between 0 and 1,052 acres of forested wetlands are scheduled for harvest, depending on alternative (Table Riparian-5, earlier in this section).

Implementation of Alternative 1 would result in a continuation of the existing condition. Only the existing timber harvest on wetlands occurring before 1995 (385 acres) would occur until after 2004. Regardless of which alternative is implemented at this time, all 1,052 acres of forested wetlands which are available are scheduled for harvest by 2004.

Indirect Effects of Roads on Wetlands

Prior to 1995, approximately three miles of road have been constructed over wetlands in the Project Area. This equates to less than one percent of all wetlands within the Project Area. The action alternatives propose up to 34.1 miles of additional road construction on wetland areas. Alternative 2 would result in the construction of 34.1 miles of roads on wetlands within the Project Area by 2004 (Table Riparian-5). Implementation of Alternatives 3,5, 6, and 7 would result in the construction of 8.4, 17.2, 6.6 and 0.0 miles of road respectively by 2004. Scheduled timber harvest within the Project Area will result in the construction of a cumulative 34.1 miles of roads on wetlands within the Project Area by 2004, regardless of which alternative is selected at this time. Clearing limits of 75 feet along proposed roads are assumed for the purpose of this analysis. Actual road design will vary. Specified roads will typically include a road surface of approximately 16-foot width and a varying width road-side ditch and/or fill-slope, depending upon slope, topography, soil type, and drainage. Typically, wetlands occur on relatively gentle slopes which require a minimum of clearing, excavation, filling, and ditching.

Cumulative Effects

Riparian Areas, Floodplains, and Wetlands

By 2140, within the Project Area, approximately 400 acres of riparian areas and floodplains, and 2,400 acres of forested wetlands will be harvested. These areas support a mosaic of even-aged stands of varying age classes and all-aged stands, the product of uneven-aged management. About 174 miles of road will have been constructed on wetlands. These management activities will incorporate TLMP Draft Revision standards and guidelines into the future. By maintaining riparian areas, floodplains, and wetland values and functions in the upcoming decades, the cumulative effects of these actions will remain within threshold levels.

Swan-Tyee Transmission Line

The Swan Lake-Lake Tyee Intertie would have minimal effects on wetlands, related primarily to clearing in forested wetlands and the permanent loss of wetlands associated with the road. The proposed action would affect about 445 acres of wetlands. The amount, frequency, and distribution of wetlands in the Intertie Project Area make them impossible to avoid.

Fisheries

Key Terms

Aelvin—newly hatched salmon that are still attached to the yolk sac.
Adfluvial—species or populations of fish that do not go to sea, but live in lakes and enter streams to spawn.
Alluvial fan channel—a fan-shaped deposit of sand, gravel, and fine material made by a stream where it runs out onto a level plain or meets a slower stream.
Anadromous—fish that ascend from the sea to breed in freshwater streams .
Channel types—the defining of stream sections based on watershed runoff, landform relief, and geology.
Estuary—relatively flat, intertidal, and upland areas where saltwater meets freshwater, as at the heads of bays and the mouths of streams.
Glide channel—channel types that occur on lowlands and landforms, and are mostly associated with bogs, marshes, or lakes.
Large Woody Debris (LWD)—any large piece of relatively stable woody material having a diameter of at least 4 inches and a length greater than 3 feet that intrudes into a stream channel; also called Large Organic Debris (LOD).
Resident fish—non-migratory fish that complete their entire life cycle in freshwater.
Riparian areas—geographically delineable areas with distinctive resource values and characteristics that are comprised of the aquatic ecosystem and riparian ecosystem.
Riparian ecosystems—a transition between the aquatic ecosystem and the adjacent terrestrial ecosystem; identified by soil characteristics or distinctive vegetation communities that require free or unbound water.
Riparian management area—the area including water, land and plants adjacent to perennial streams, lakes and other bodies of water that is managed for the inherent qualities of the riparian ecosystem.
Salmonid—refers to the taxonomic group of fishes to which salmon belong.
Watershed—area that contributes runoff water to a waterway.

Affected Environment

Introduction

Fish and aquatic resources in the Upper Carroll Project Area help support subsistence, commercial, and sport fisheries. Abundant rainfall and watersheds with high drainage densities provide a number of diverse fish spawning and rearing habitats.

The fishery resources are important to the economy and life-styles of area residents and its visitors. Residents from the community of Saxman are regular subsistence users. Sport and commercial fisheries attract people from Ketchikan, Neets Bay, Juneau, and Thorne Bay (Resource Harvest Map, 1990, Alaska Department of Fish and Game).

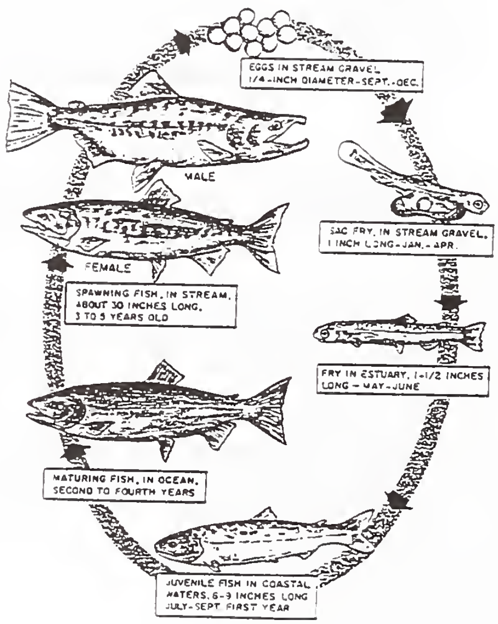
The Project Area contains an existing fish hatchery at Neets Bay, a proposed fish hatchery, and a terminal king fishery at Swan Lake managed by Southern Southeast Regional Aquaculture Association (SSRAA).
Four species of salmon (pink, chum, sockeye, and coho), cutthroat/rainbow trout, and one species of char (Dolly Varden) inhabit the freshwater within the area. A landlocked variety of sockeye salmon, the kokanee, is found in Orchard Lake. King salmon are found in the inlets and bays of the Project Area. Some spawn in Carroll Creek drainage. These fish species are valuable to the commercial fish industry, resident sport fisheries, subsistence use, and charterboat/lodge operators, and are also a valuable food source for bears, eagles, and other wildlife. A number of nongame fish species including sculpin, stickleback, and smelt occur in Project Area waters (Taylor 1979).

Anadromous fish spend at least part of their life in freshwater and part in saltwater. Salmon lay their eggs in stream gravels, and the juvenile fish hatched from the eggs emerge from the gravels. Depending on the species of salmon, the amount of time the juveniles spend in freshwater is variable. Pink salmon immediately start their downstream migration from emergence, while coho salmon juveniles generally spend two years in freshwater before migrating to the ocean. Pink and chum salmon are especially dependent on estuaries during their early life stages. Salmon reach maturity out in the ocean, only to return to their natal streams to start the cycle again. Steelhead trout follow a cycle similar to coho salmon, except they often survive the spawning season, return to the ocean, and spawn again.

Resident trout and char spend all of their life in freshwater, spawning in stream bed gravels and growing to maturity in the streams and lakes of the area.

In the Project Area, major estuaries are located at the head of Neets Bay and Carroll Inlet. Additional small estuaries are found at the outlet of smaller stream systems throughout the Project Area.

Figure Fisheries-1
Lifecycle of Chum Salmon



Estuaries are unique systems because they form transitions between terrestrial freshwater and marine environments. Estuaries are rich and diverse, harboring many resident species and providing food, spawning areas, or shelter for numerous other species at critical points in their life cycle (USDA Forest Service 1985). On Revillagigedo (Revilla) Island, crab, shrimp, clams, mussels, and various marine fishes are associated with the estuaries and surrounding waters, which form a nursery for their young. Herring and smelt also use these areas for spawning and feeding.

Fish Habitat

Fish habitat is described in several ways, including: (1) stream classification, (2) watersheds, and (3) habitat capability.

Stream Classification

Three classifications of fish use of streams and lakes, originally named Aquatic Habitat Management Units (AHMU), have been identified for the Tongass National Forest. In a letter dated November 21, 1995 the Regional Forester outlined a more comprehensive classification system in response recommendations in the Anadromous Fish Habitat Assessment Report (AFHA). Stream Class definitions are as follows:

- *Class I*—Streams with anadromous or adfluvial lake and stream habitat; or high quality resident fish waters listed in Appendix 68.1, Region 10 Aquatic Habitat Management Handbook (FSH 2609.24), June 1986; or habitat above fish migration barriers known to provide reasonable enhancement opportunities for anadromous fish.

- *Class II*—Streams with resident fish populations and generally steep (often 6-15 percent) gradient (can also include streams from zero to five percent gradient where no anadromous fish occur). These populations have limited sport fisheries values. These streams generally occur upstream of migration barriers or are steep gradient streams with other habitat features that preclude anadromous or adfluvial fish use.

- *Class III*—Perennial and intermittent streams with no fish populations, but which have sufficient flow or transport sufficient sediment and debris to have an immediate influence on downstream water quality or fish habitat capability. These streams generally have bankfull widths greater than five feet and are highly incised into the surrounding hillslope.

- *Class IV*—Other intermittent, ephemeral, and small perennial channels with insufficient flow or sediment transport capabilities to have an immediate influence on downstream water quality or fish habitat capability. These streams generally are shallowly incised into the surrounding hillslope.

- *Non-streams*—Rills and other watercourses, generally intermittent and less than one foot in bankfull width, with little or no incisement into the surrounding hillslope, and with little or no evidence of scour.

This stream classification system will be incorporated as an update to the Region 10 Aquatic Habitat Management Handbook. The addition of Class IV and Non-streams classification categories should not change existing stream protection requirements contained in existing timber sale contract provisions and the Best Management Practices (BMP) Handbook. These new stream class categories will result in more accurate delineation of streams in the field (BMP 13.3), and more uniform and objective implementation of stream channel protection measures (BMP 13.16). As this direction was signed after most field reconnaissance was completed, Class IV streams will be identified by Fisheries Biologists during harvest unit layout.

All mapped streams in the Project Area have been assigned a channel type (USDA Forest Service 1992). Channel typing, as developed on the Tongass National Forest, is an inventory and planning tool that stratifies stream and lake sections within a watershed into different stream process groups. The process groups are based on physical characteristics of streams and predict their physical response to different management activities. For an in-depth description of stream process groups, see Appendix D of the TLMP RSDEIS (1996a).

Channel types are used to assign stream classes, particularly if stream-specific information is unavailable. There are approximate 230 miles of streams in the Project Area. Approximately 36 miles of stream in the Project Area are classed as accessible to anadromous fishes (Class I), and 43 miles are inhabited by resident fishes (Class II), see Table Fisheries-1.

Streams in the Carroll Creek watershed were field verified from the mouth of Carroll Creek upstream until it was determined that the stream did not contain fish habitat. Subsequent field reconnaissance during unit layout may identify additional streams. For those streams, the stream class and channel type will be determined and the appropriate management prescriptions applied to protect stream habitat and water quality.

Channel types are also an indicator of the amount and quality of fish habitat within the Project Area. The amount and quality of rearing habitat predicted by the various channel types has been established through field studies within the Tongass National Forest (Murphy et al. 1987).

Table Fisheries-1 displays the aquatic habitats by VCU, miles of Class I, II, and III streams, and acres of estuary buffer zones and lakes.

Table Fisheries-1
Aquatic Habitats by VCU

VCU	Miles Class I	Miles Class II	Miles Class III	Acres Estuary	Acres Lakes
737	12.2	.8	42.1	67.2	225
744	20.2	35.1	93.3	437.0	138
746	3.5	6.7	16.7	38.0	4
Total	**35.9**	**42.6**	**152.1**	**542.2**	**367**

SOURCE: Ketchikan Area GIS database. 1996

Watersheds

There are more than 230 miles of streams within the Project Area. The Project Area can be categorized into a number of watersheds, or areas that contribute runoff water to a particular waterway. These categories enable biologists to evaluate various management activities on fish habitat and its capability to produce fish. Many watersheds in the Project Area contain streams that have no name other than the Alaska Department of Fish and Game (ADF&G) Anadromous Stream Catalog number. For a summary of miles of stream in the Project Area, see Table Fisheries-1.

In addition to streams, the Project Area has approximately 365 acres of lakes and 540 acres of estuary buffer zones. These areas also provide high quality fish rearing habitat.

It is common for several species of anadromous salmon and trout to use the same reach of stream for migration, spawning, and rearing. Where resident fish occupy the same reaches of the stream as anadromous fish, the resident trout are not found in large numbers. Watersheds within the Project Area that have the potential for quality sport fishing include Carroll Creek and Orchard Creek.

On Neets Creek, a short distance (0.1 mile) above its outlet, a 15-foot barrier falls blocks the migrating salmon from traveling upstream. Farther up stream, a southern branch leads to Neets Lake where cutthroat may be found. A little farther up the valley lies Bluff Lake, named for its steep sides. Originally a cutthroat lake with kokanee salmon, no kokanee have been caught for more than 10 years. Only in the short intertidal zone are there any spawning areas for pink, chum, and Dolly Varden. The two valley lake basins were extensively logged from 1957 through 1959.

The Carroll Creek watershed encompasses approximately 26,885 acres. The mainstem of Carroll Creek is approximately six miles in length with the lower 2.5 miles accessible to anadromous salmonids. Approximately 2.5 miles upstream from Carroll Inlet there is a bedrock waterfall that appears to be a complete barrier to upstream migration of anadromous salmonids.

Carroll Creek (ADF&G stream no. 101-45-78) is located at the head of Carroll Inlet on Revillagigedo Island. Carroll Creek supports anadromous runs of steelhead (*Oncorhynchus mykiss*), king (*O. tschawytscha*), pink (*O. gorbuscha*), coho (*O. kisutch*), and chum salmon (*O. keta*). The creek also sustains populations of Dolly Varden (*Salvelinus malma*), cuttthroat trout (*O. Clarki*), and rainbow trout (*O. mykiss*).

Carroll Creek has a fairly large estuary (170 acres) with numerous tidal channels that are utilized by estuarine fish for feeding during high tides. The Carroll Creek estuary is characterized by extensive grass flats which are inundated at higher tides down to mud flats and eel grass beds which are exposed at minus tides.

In 1963 and 1964, approximately 700 acres of this watershed was timber harvested utilizing the clearcut method. The harvest activity focused primarily in the lower basin and targeted the most accessible areas.

ADF&G and the SSRAA have been involved in the management of king salmon stocks in Carroll Creek. As early as 1961, fry were planted in the system. In 1982, a study was launched by SSRAA to determine if Chickamin River stock would successfully adapt to an island river system. Since 1986, SSRAA has annually released up to 1.2 million smolts from net pens located in Carroll Inlet.

Table Fisheries-2 summarizes additional information on these important stream systems within the Project Area and fish species found in them.

Table Fisheries-2
Major Streams within the Project Area and Fish Species

VCU	Stream Name	Watershed Number	Anadromous Miles	Resident Miles	Watershed Acres	Fish Species
737	Neets Creek/ Bluff Lake	C41B	0.8	8.2	7,646	Pink, Chum, Dolly Varden, Cutthroat
744	Carroll Creek	D70C	21.4	17.4	26,885	Pink, Chum, Coho, Sockeye, Dolly Varden, Cutthroat Steelhead, King

SOURCE: Ketchikan Area GIS database. 1996

Most other streams are short direct streams to saltwater

Habitat Capability

Large Woody Debris

Large Woody Debris (LWD)—trees and tree pieces greater than 4 inches in diameter and 10 feet long—is one of the most important components of high quality fish habitat. Also known as Large Organic Debris (LOD), this material provides food and building materials for many aquatic life forms, provides cover for juvenile and adult fish, and is a primary habitat-forming element in some channel types.

The maintenance of woody riparian vegetation is important as a source of nutrient input. As debris accumulates in streams, it creates pools, traps nutrient-laden organic matter, and supports aquatic insects and other food items for fish. Studies on the effects of LWD on streams similar to those in the Project Area have provided insights into its function. In Staney Creek, LWD decreased flows and increased the abundance of aquatic insects (Salo 1972). Shaheen Creek studies compared old growth, buffered, and clearcut area effects on LWD and habitat characteristics, finding that LWD provided by buffer zones was able to support higher coho densities from summer through winter by protecting important winter habitat (Uberuaga 1983).

Gradual entry of LWD into the aquatic system is desirable to maintain stream habitat diversity and stability. Large amounts entering abruptly can be detrimental to the aquatic ecosystem by becoming a physical barrier and causing bank erosion and channel migration problems. In most cases, however, gradual and consistent input of LWD is important to maintain stream productivity (Harris 1989).

Past management practices have reduced the total amount of large in-channel woody material in Neets Creek and lower Carroll Creek. Prior to the enactment of TTRA, timber often was harvested to the edge of the streams, and stream cleaning operations were commonly conducted to prevent perceived fish passage problems. Cleaned streams have consistently shown lower over winter survival rates than unharvested or harvested-but-buffered streams (Heifetz et al. 1986, Bryant 1983, 1985, Bjornn et al. 1991).

Blowdown of Trees

Blowdown of trees is a natural phenomenon in Southeast Alaska. There is evidence to show that blowdown does not occur randomly. Natural factors and shape of created openings determine the probability of blowdown occurring in adjacent stands (Harris 1989; Moore 1977). Site-specific fisheries mitigation measures such as timing, road crossings, and stream and lake protection zones are contained on the Unit Cards (Appendix K). These will be refined during field layout of the units to reduce blowdown hazard. In addition, the boundary of the retained vegetation may be moved away from the stream, to a maximum distance of the entire RP, to provide a windfirm zone. A limited amount of blowdown can contribute to the LWD needed to maintain in-stream habitat.

Stream Temperature

Summer high and winter low water temperatures influence fish survival and condition. Water temperature affects the metabolic rate of aquatic organisms and can affect the migration timing of adult and juvenile fish. Small changes in water temperature can affect emergence of fry from the gravels and have a fairly large effect on eventual adult survival (Holtby and Scrivener 1989). Reductions in canopy cover may produce increased temperatures in summer and reductions in winter.

The shading of streams is important because direct-beam solar radiation is the primary factor influencing temperature change in summer. The effect on stream temperature of reducing canopy cover is directly proportional to the reduction in shade to the stream. Buffer strips along streams provide a relative degree of shading depending on a number of factors including vegetative structure and density. Another factor is the measure of the angle of the sun to the canopy and slope of the ground. Buffer strips with widths of 100 feet or more generally provide the same level of shading as that of an old-growth stand (Beschta et al. 1987). Harvest of streamside vegetation, as well as the total amount of harvest in a watershed, can affect water temperature. The Thorne River and salmon-producing tributaries of the Staney Creek watershed stream temperatures were reported to increase much more rapidly in logged than in unlogged study areas due to removal of streamside vegetation. Rates of increase in water temperature between similar study areas indicated 0.28 Celsius/100 feet (0.50 degrees Fahrenheit) through logged areas and 0.02 Celsius/100 feet (0.04 degrees Fahrenheit) through unlogged forest (Taylor and Gibbons 1973).

Timber harvest to the streambank is suspected of raising stream temperatures to a level which may contribute to adult fish kills, although no direct link has been established (Beak 1989, Konopacky 1991). Two major streams within the Project Area, Neets and Carroll Creeks, have had past harvest on their banks. No fish kills due to temperature have been documented in the Project Area.

The TLMP Draft Revision proposes that no more than 35 percent of the land area in a watershed be commercially harvested within a 15 year time span. This allows for recovery of the watershed and a reduction of stream temperature sensitivity before any additional harvest may take place within the watershed (USDA Forest Service 1991a). Temperature-sensitive watersheds which exceeded this threshold were not found within the Project Area. See the Water Resources section in this chapter for further discussion.

Pre-TTRA harvest practices may continue to effect temperature sensitive streams. These may continue until natural reforestation replaces the canopy cover. Temperature studies on Staney Creek, Prince of Wales Island, revealed that three-year regrowth of vegetation along stream banks after logging did not protect the stream from solar radiation (Salo 1972). Every effort will be made through application of TTRA, Riparian, and high MMI (MMI-4) soils buffers, in accordance with the Aquatic Management Handbook, to minimize effects of timber harvest and road construction on stream systems.

Low winter temperatures can lead to detrimental winter stream conditions, such as anchor ice formation and freezing of spawning gravels, which can reduce pool size. Low temperatures may be aggravated by removing streamside vegetation. However, estimating the effects is very difficult because of the influences of intermittent snow or ice cover and high variability in winter air temperature and the influence of wind and precipitation patterns commonly found in Southeast Alaska.

Sedimentation

Aquatic productivity can be influenced by the concentration of sediment in the water column and the amount of fine sediment introduced into spawning gravel. Direct impacts from sediment concentration include filling gravel pore spaces, which reduces water circulation necessary for fish egg and fry survival and growth. Sediment also retards emergence of the young fish after hatching. Young fish can die within the gravel if fine sediment blocks their movement through gravel to open water. During winter, young salmonids use spaces between gravel and rubble to escape the effects of low water temperatures and ice. When these spaces fill with sediment, the young fish must emerge from the gravel and use energy to maintain themselves in the current, reducing their ability to survive.

Suspended sediment may also irritate the mouth and gills of young fish, and if persistent, can erode the gills of larger fish. Such damage may increase fish stress, leading to increased susceptibility to disease. As rearing pools fill with sediment, rearing space is reduced, lowering habitat capability, and increasing stress and vulnerability to predators. Sediment indirectly affects fish by reducing populations of aquatic insects which are important fish food, increasing competition for food items, weakening unsuccessful feeders, and reducing the number of fish that can be produced from a stream section. Salmonids are generally sight feeders, and turbid water reduces their feeding efficiency.

Introduction of sediment can affect survival of fish eggs and newly emerged fry (aelvins). Therefore, road and fish-pass stream crossing construction activities and use of equipment in Class I streams are allowed to occur only when eggs or aelvin are not in the stream gravels. Road construction activities are not allowed when adult salmon enter stream systems to avoid disturbance during spawning. The windows for in-stream operations can vary slightly from stream to stream and site to site. Site specific fisheries and field information (including ADF&G recommendations) are used to determine the operating windows and will be applied to the Project Area. In the Ketchikan Administrative Area, the windows for allowed instream operations are generally established to be June 1 to August 7 for pink and chum salmon, June 15 to September 1 for coho salmon, and July 18 through August 7 for steelhead trout. However, these operations windows can vary from site to site within the stream system and throughout the Project Area. Site-specific information on timing restrictions may be found in Appendix K, Unit Cards.

A discussion of the physical factors contributing to fish habitat quality and quantity, including sedimentation, water chemistry, and streamflow regimes occurs in the Soils and Water Resources sections of this chapter.

Management Indicator Species

Management Indicator Species (MIS) are species whose population changes are believed to best indicate the effects of land management activities (USDA Forest Service 1982). Through the MIS concept, the total number of species occurring within a Project Area is reduced to a manageable set of species that collectively represent the complex of habitats, species, and associated management concerns. The MIS are used to assess the maintenance of population viability, changes in biological diversity, and effects on species in public demand.

In this EIS, coho and pink salmon and Dolly Varden are the MIS used to evaluate the environmental consequences of the alternatives on fish habitat capability. The models are indicators of projected changes in habitat due to management practices. Their purpose is to assist in making comparisons between alternatives by management (see the Wildlife section in this chapter for further explanation). The results from the habitat capability models can not be interpreted as precise estimates of rearing fish biomass or actual fish production. Anadromous fish use of a variety of habitats and prior timber harvests in riparian stream bottoms or stream enhancement projects were part of the complexity of the fish habitat capability model.

Coho and pink salmon have been selected as MIS for anadromous fish species and represent two different phases of salmon life history: spawning/egg incubation and freshwater rearing. Dolly Varden char was selected to represent resident species for the Upper Carroll Project Area. Anadromous fish spend at least part of their life in freshwater and part in saltwater. Salmon lay their eggs in the stream gravels, and the juveniles hatched from the eggs emerge from the gravels. Depending on the species of the salmon, the amount of time the juveniles spend in fresh water is variable before maturing in the ocean. Resident trout and char spend all of their life in fresh water, spawning instreambed gravels and growing to maturity in the streams and lakes of the area.

Coho Salmon

Coho salmon are highly dependent on quality rearing habitat for their health, growth, freshwater survival, and marine survival. Coho juveniles spend an average of two years in freshwater streams and rivers, attaining a size of about four to six inches, before migrating to saltwater, as out-migrating smolts. In the ocean, smolts mature on average of two years and reach six to 20 pounds and become important to the commercial troll, marine sport fishery, and local subsistence fisheries of the area. An average of 1.67 million fish per year between 1979 and 1988 (Forest Service 1991a), were harvested in Southeast Alaska.

Because cohos spend more time in freshwater, habitat capability for this species is limited not only by the quantity and quality of spawning gravel, but also by the ability of the freshwater to support overwintering young salmon. Small lakes, backwater ponds, and pools formed by LWD provide this overwintering habitat (Irvine and Johnston 1992, Nickelson et al. 1992a, Nickelson et al. 1992b). In summer, relatively deep pools in small streams are preferred (Bugert 1991). Buffers (100 foot or greater, of stable, windfirm, old growth) along with RPs are designed to provide a continuous supply of LWD to maintain coho spawning and rearing areas.

Coho habitat capability on Table Fisheries-3 represents the estimated potential for salmon production in the Upper Carroll Project Area.

Table Fisheries-3
Coho Habitat Capability Effects and Percent Change from 1954 to 1995.*

1954	1995	Percent
48,557	43,916	-10

SOURCE: Matson 1995

Pink Salmon

Pink Salmon (humpback) are the most widely distributed of the salmon. Pink salmon are important to the commercial fishery of Southeast Alaska, where they represent the greatest poundage harvested; an average of 85 million pounds were harvested between 1979 and 1988 (USDA Forest Service 1991a). Their juveniles go to sea immediately upon emergence from the gravels of coastal streams. Pinks mature in the ocean for two years before returning to their natal streams to spawn and die. Spawning gravel quantity and quality limits pink salmon spawning habitat capability. Substrate composition, water quality and quantity, and water depth and velocity are critical to successful salmon spawning and incubation. Spawning generally occurs in riffles as incubating eggs need a constant supply of clean well-oxygenated water.

Management actions that increase stream sediment levels, destabilize stream spawning habitat, and alter accessibility to migrating juveniles and adults harms spawning and incubating habitat. Increased sediment levels can affect egg survival by depriving the eggs of oxygen. Activities that affect fish passage, reduce migratory holding areas, increase stream temperature, and decrease dissolved oxygen can also effect juvenile and adult migration. Migratory holding areas are deep, quiet pools where adults like to rest. Timber harvest near a stream can cause changes in streambank stability, lateral scouring and sedimentation. These factors affect a watershed's ability to retain storm runoff and flood waters.

The model estimates of pink habitat capability are based on estimates of available spawning habitat in the VCU streams. This was done by first determining average pink salmon spawning area by channel type for Tongass National Forest streams that are typically used by pink salmon and not other species. These estimates were then applied to streams in each VCU that are accessed by pink salmon. Unlike coho habitat capability estimates, the pink salmon model estimates are not influenced by prescribed management activities. This is due to the fact that studies inside Southeast Alaska have not developed a specific correlation between upland (land not immediately adjacent to streams) management and pink salmon numbers that can be used to quantitatively model changes in habitat over time.

Table Fisheries-4
Pink Habitat Capability Effects and Percent Change from 1954 to 1995 Within the Upper Carroll Project Area

1954	1995	Percent
2,975,906	2,975,906	0

SOURCE: Matson 1995

Dolly Varden

Dolly Varden char were selected to represent resident fish habitats because of their wide distribution, availability of data on the species' habitat requirements, and distribution over the full spectrum of resident fish habitats. Dolly Varden are also present in their anadromous form in the area.

Spawning gravel, water quality and quantity, water depth and velocity are important habitat components for Dolly Varden spawning and successful incubation of eggs to fry. Dolly Varden, like coho salmon, are highly dependent on quality rearing habitat for their health, growth, freshwater survival, and marine survival. Dolly Varden juveniles spend one to four years in fresh water before migrating to salt water as out-migrating smolts. Dolly Varden habitat capability, like coho habitat capability, is directly influenced by LWD recruitment. Anadromous Dolly Varden habitat needs are much like that of the coho salmon, with the exception that some Dolly Varden may live their whole life in freshwater. Table Fisheries-5 shows Dolly Varden habitat capability, effects, and percent change from 1954 to 1995. Reductions in habitat capability due to previous harvesting practices may be offset by rehabilitation under Knudson-Vandenburg (KV) or other eligible funding for proposed projects on Neets and Carroll Creeks. See Appendix I on Sale Area Improvement/KV Opportunities for further details.

Table Fisheries-5
Dolly Varden Habitat Capability Effects and Percent Change from 1954 to 1995* Within the Upper Carroll Project Area

1954	1995	Percent
168,856	154,399	-9

SOURCE: Matson 1995

Riparian Management Areas

The National Forest Management Act (NFMA), Section 219.27 (12)(e), requires that riparian management areas (RMAs) be established to conserve soil and water resources and to prevent permanent impairment of the productivity of the land. RMAs are not an exclusion; rather, they are areas where topography, vegetation, soil, climatic conditions, management objectives, and other factors are to be considered in determining management practices and constraints. RMAs comprise the aquatic and riparian ecosystem, and the adjacent floodplain, wetlands, and upland areas with potential to deliver sediment to channels.

Estuaries and Beach Fringe

Beach fringe is established 500 feet slope distance inland from average high tide. For planning purposes, the buffers created in GIS are 500 feet horizontal distance, which exceed or meet the requirement.

Estuaries are established 1,000 feet slope distance inland from average high tide. For planning purposes, the buffers created in GIS are 1,000 feet horizontal distance, which exceed or meet the requirement.

Status of Riparian Management Areas

Stream sections were defined according to their characteristics by the Alaska Region Channel Type Classification System, and are divided into nine basic river and stream process groups. The eight process groups occur in the Project Area. Table Fisheries-6 displays the overall condition of RMAs by process group when totaled for the Upper Carroll Project Area. This table shows the total length of stream and lake process groups.

Table Fisheries-6
Status of Riparian Management Areas (RMAs)

Stream Process Group	Total RP Miles	Total RP Acres
Estuarine	5.0	532.0
Palustrine	6.2	239.5
Floodplain	16.9	688.0
Alluvial Fan	8.8	195.7
Large Contained	1.9	32.5
Moderate Gradient Mixed Contained	13.8	279.8
Moderate Gradient Contained	9.8	204.0
High Gradient Contained	163.0	3,595.9
Lakes	4.6	186
Total	**225.5**	**5767.4**

SOURCE: Ketchikan Area GIS database. 1996

Table Fisheries-7 displays the amount of Riparian Management Area harvested before 1995 by VCU. Percent of the RMA harvested is displayed to show the impact on future supplies of LWD.

Table Fisheries-7
Status of Riparian Management Areas by VCU

VCU	Total RMA Acres	Acres* of RMA Harvested Before 1995	Percent of RMA Harvested Before 1995
737	639.7	336.3	52.6
744	2,181.9	192.2	8.8
746	358.5	18.8	5.2
Total	**3,180.1**	**547.3**	**17.2**

SOURCE: Ketchikan Area GIS database. 1996

* These RMA's acres were harvested prior to passage of TTRA.

Effects of the Alternatives

Legal and Management Requirements

The TTRA provides direction for fisheries protection in section 103(a). The objective of this section of TTRA is to assure the protection of riparian habitats and to protect fisheries through the application of buffer zones not less than 100 feet in width on Class I and some Class II streams and through the application of BMPs. The Act reads:

> (a) Section 705 (16U.S.C. 539d) of ANILCA is amended by adding at the end thereof the following new subsection: "(e) In order to assure protection of riparian habitat, the Secretary shall maintain a buffer zone of no less than one hundred feet in width on each side of all Class I streams in the Tongass National Forest, and on those Class II streams which flow directly into a Class I stream, within which commercial timber harvesting shall be prohibited, except where independent national forest timber sales have already been sold. The Secretary shall use best management practices, as defined in the Region 10 Soil and Water Conservation Handbook (FSH 2509.22), January 1990, to assure the protection of riparian habitat on streams or portions of streams not protected by such buffer zones. For the purposes of this subsection, the terms Class I streams and Class II streams means the same as they do in the Region 10 Aquatic Habitat Management Handbook (FSH 2609.24), June 1986."

The National Forest Management Act (NFMA) sets the minimum standard for fish habitat protection on all national forests. TTRA further provides specific direction for fish and riparian protection for the Tongass National Forest.

The NFMA regulations (36 CFR 219.27 (e)) state, in part:

"No management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment shall be permitted within these areas [riparian areas] which seriously and adversely affect water conditions or fish habitat."

Buffers are assigned to streams based upon both stream class and channel types. By considering both stream class and channel type, additional buffers or other protection measures can be specified in order to maintain or enhance fish habitat and water quality. In no case are buffers being considered which are less than those required by TTRA.

The interdisciplinary team (IDT) used the Forest Plan Revision Standards and Guidelines for riparian protection to establish the TTRA buffers, additional no-cut buffers, and additional partial cut buffers. This was done for each inventoried stream based on its stream class and channel type. The IDT then overlayed these buffers with the potential units. A watershed analysis was completed for Carroll and Neets drainages. The results of this analysis was incorporated into the design of harvest units and the utilization of mitigation measures. This will help minimize impacts to watersheds as a result of timber harvest and road construction activities. Aerial photos were examined to determine if buffers had to be wider to account for windfirmness, logical units, and small slivers between buffers. During layout, if additional streams are found, the same standards and guidelines are used to establish buffers for each stream based on its stream class and channel type.

The Tongass Timber Reform Act Section 103(e) specifies "*...maintain a buffer zone of no less than 100 feet in width on each side of all Class I streams in the TNF, and on those Class II streams which flow directly into a Class I stream, within which commercial timber harvesting shall be prohibited...*". In a November 21, 1995 memo to the Forest Service, the Regional Forester issued the following direction for implementing TTRA section 103(a) on the Tongass National Forest:

> All Class II branches of a Class II stream, that flow into a Class I stream without a mappable intervening Class III, Class IV , or nonstream segment, will be considered part of the Class II stream which "...flow directly into..." the Class I stream.
>
> Mandatory minimum 100 foot buffers will not apply to: 1) A Class II stream that flows directly into the ocean, or joins a Class I stream only at lower than mean high tide; and 2) A Class II stream segment that flows into a mapable Class III, Class IV, or nonstream segment that in turn flows into a Class I stream. These two instances clearly do not "...flow directly into..." a Class I stream.
>
> On all Class III streams, Class IV streams, non-streams, and those Class II streams or segments which do not "...flow directly into..." a Class I stream, provisions of the Alaska Region Best Management Practices (BMPs) in the Regional Soil and Water Conservation Handbook (FSH 2509.22) apply to ensure riparian protection. These handbooks provide for field level professional judgement regarding whether to prescribe variable buffer widths for individual streams, beyond the minimum buffers required by TTRA section 103 (a), in order to meet our fish habitat and water quality goals.

In a memo to District Rangers dated December 31, 1992, the Forest Supervisor directed that actions be taken immediately to ensure that all TTRA buffers meet the minimum 100-foot width, or the minimum width prescribed to meet the standards and guidelines for the streams when the buffer is greater than 100-feet in width. These acts include a quality control program to ensure accurate measurement of the minimum buffer width and length, statistically random sampling techniques to monitor the TTRA units, and finally, training personnel to fully implement TTRA. The District Ranger will be held fully accountable for proper implementation of TTRA requirements. Monitoring will focus on concerns about application and adequacy of buffer prescriptions.

Direct, Indirect, and Cumulative Effects

Fish Habitat

Timber harvest has potential positive and negative effects on fish habitat capability. Timber harvest may affect the sources of LWD, stream stability, water flow, and quality. These effects may be mitigated by Riparian LUDs (RP), Very High Mass Movement Soil (MMI 4), and TTRA buffer requirements. Timber harvest, under some circumstances, may have a positive effect on fish by increasing the amount of primary productivity in a stream system. However, these potential positive effects, which are generally only seasonal in nature, may be diluted by increased flows and are not quantified in this assessment.

Objectives for management affecting fish habitat in this EIS include:

1. Maintain or improve fish habitat capability in channel process groups.
2. Maintain natural streambank and stream channel processes.
3. Maintain natural and beneficial quantities of LWD over the short and long term.
4. Maintain water quality to provide for fish production.
5. Maintain optimum water temperatures for salmonids, considering both winter and summer habitat requirements, climate, and natural watershed characteristics.
6. Maintain or improve primary or secondary stream biological production in second-growth forest.
7. Maintain fish passage through stream crossing structures.

The habitat capability models predict that there was a decrease in coho capability of 9.6 percent (from 48,557 smolts in 1954 to 43,916 smolts in 1995). This was caused by earlier timber harvest activity that removed trees right up the stream banks, which resulted in a loss of LWD input into the streams. A continued decrease in habitat capability is predicted to continue for another 100 years until the time that trees are old enough to start dying and again contributing LWD to the streams. Dolly Varden inhabiting Class I streams and Class II streams that flow directly into Class I streams will not be significantly affected by commercial timber harvest alternatives. The Dolly Varden Habitat Capability Model predicts a 8.6 percent decrease in habitat capability (from 168,856 smolts in 1954 to 154,399 smolts in 1995). Habitat capability for pink salmon remains constant from 1954, to the present and into the future. As previously explained, the model does not include upland effects and may not accurately portray future conditions.

The direct effects on fish habitat capability is common to all alternatives. Direct, indirect, and cumulative changes in fish habitat capability seen in Tables Fisheries-8, Fisheries-9, and Fisheries-10 are due to past harvest activities.

Table Fisheries-8
Coho Habitat Capability Effects and Percent Change from 1954 to 2140*

1954	1995	%	1998	%	2004	%	2140	%
48,557	43,916	-9.6	43,723	-10.0	43,275	-10.9	42,736	-12

SOURCE: Matson 1995

* Includes lake production
Note: % = Percent difference between 1954 and indicated year

Table Fisheries-9
Dolly Varden Habitat Capability Effects and Percent Change from 1954 to 2140*

1954	1995	%	1998	%	2004	%	2140	%
168,856	154,399	-8.6	153,776	-8.9	152,325	-9.8	150,800	-10.7

SOURCE: Matson 1995

* Includes lake production
Note: % = Percent difference between 1954 and indicated year

Table Fisheries-10
Pink Habitat Capability Effects and Percent Change from 1954 to 2140*

1954	1995	%	1998	%	2004	%	2140	%
2,975,906	2,975,906	-0	2,975,906	-0	2,975,906	0	2,975,906	-0

SOURCE: Matson 1995

* Includes lake production
Note: % = Percent difference between 1954 and indicated year

Riparian Areas

With increased developmental activities there is an added risk of unplanned stream-habitat impacts (such as accelerated numbers of landslides over background levels, blowdown of leave strips, and the subtle impacts that may result from stream reactions to rain-on-snow events), and cumulative effects of many small but individually insignificant actions affecting the riparian zone. Harvest on MMI 3 (high mass movement index) soils, miles of road construction and reconstruction, and the number of stream crossings, are indicators of potential increased risk that may temporarily affect the sources of LWD, stream stability, and water quality. See the Soils Section, Table 3-8 for acres of harvest on MMI 3 soils; Transportation Section, Table 3-123 for miles of road construction/reconstruction, Table 3-129 for the number of stream crossings; to get an idea of the amount of potential increased risk between the various alternatives. However, BMPs, Alaska State and Federal regulations and requirements will be complied with or exceeded to minimize these effects.

There will be no timber harvest within TTRA buffers other than incidental right-of-way clearing associated with stream crossings or skyline corridors. Harvest is authorized within Riparian Management Areas. Table Fisheries-11 displays the harvest activities within RPs for each alternative.

Table Fisheries-11
Acres of Total Harvest in Riparian Management Area by Alternative

	Alternative					
	1	2	3	5	6	7
Acres of Harvest	0	121.3	61.9	135.4	116.7	4.0

SOURCE: Ketchikan Area GIS database. 1996

Road clearing within TTRA buffers is detailed in the Transportation section.

Temperature-Sensitive Streams

All watersheds within the Project Area meet the TLMP (1991a) Standards and Guidelines for temperature sensitivity by limiting harvest to 35 percent of the watershed land base within a 15-year period. Implementation of any of the alternatives under consideration would not exceed this threshold.

Individual units were analyzed for their potential effects on temperature-sensitive tributaries. While required TTRA buffers will mitigate most temperature-sensitivity concerns, there still is concern about providing topographic shading to Class III streams that flow through harvest units. Characteristics that contribute to temperature sensitivity include one or more of the following: south-facing slopes, lack of immediate downstream forested stream buffers, historical and continued harvest activities, shallowness, flow, adjacency to ponds or muskegs, and fish production (FSH 2609.24 Appendix 4). Units identified with the potential for temperature sensitivity have been identified in the Watershed Analysis (Appendix F). Individual units will be field reviewed on a site-specific basis during implementation to mitigate the effects of timber harvest.

Fish Project Opportunities

Knudsen-Vandenburg (KV) Funds made available from timber sale receipts can be used for projects that enhance non-timber resources in the Project Area. Currently identified potential fish habitat rehabilitation projects include work in Carroll and Neets Creeks. Additional opportunities to work in stream reaches affected by past management activities exist in many other smaller Project Area watersheds. The projects will require additional NEPA analysis prior to implementation. Maintenance and monitoring will be established on approved KV funded projects.

Fish habitat improvement opportunities have been identified in the Carroll Creek watershed. A plan to construct a fish ladder and introduce Chinook salmon, and possibly coho, to that part of the watershed above the barrier falls was developed in 1983. This plan was never implemented as the costs of the project were significantly greater than the projected benefits. No other fish habitat improvement opportunities have been identified in the Upper Carroll Project Area.

No water quality improvement needs have been identified within the Upper Carroll Project Area, including the Neets and Carroll Creek watersheds. Public comment has stated that "*sedimentation problems*" occur within these watersheds, yet no documentation or supporting evidence has been presented, nor is the Forest Service aware of any such evidence. Watershed inventories conducted prior to the planning of this project have not identified any significant sediment sources beyond natural sources, nor proposed any measures to restore these watersheds. Watershed restoration opportunities and needs are documented in the Ketchikan Ranger District's *Watershed Improvement Needs Inventory (WINI).*

There are also opportunities to improve access, provide interpretive education on, and utilize the Project Area recreational fisheries through KV funds in such areas as Carroll Creek.

Swan-Tyee Power Transmission Line

It is not anticipated that the Swan Lake-Lake Tyee Powerline Intertie Project will significantly increase cumulative effects that have already been analyzed for the Upper Carroll Project. Table Fisheries-12 displays the acres of additional right-of-way (ROW) clearing by VCU that would occur as part of the powerline construction. The cumulative effects of construction, crossings, loss of LWD, and increases in sedimentation will be the same as those analyzed for the Upper Carroll Project. The reason for this is that the proposed road location from Carroll Inlet to Neets Bay is the same as the proposed location of the powerline.

Table Fisheries-12
Additional Powerline ROW Clearing within the Upper Carroll Project Area

	Alt. 2		Alt. 3		Alt. 5		Alt. 6		Alt. 7	
VCU	Acres	MBF	Acres	MBF	Acres	MBF	Acres	MBF	Acres	MBF
737	9	361	0	0	0	0	0	0	0	0
744	40	815	24	707	31	815	31	815	6	189
Totals	**49**	**1,176**	**24**	**707**	**31**	**815**	**31**	**815**	**6**	**189**

Acres and Volumes based on GIS TIMTYP Layer

Source: GIS, Marks, 1996

Wildlife

Key Terms

Carrying capacity—the maximum number of a wildlife species that a certain area will support through the most critical period of the year.
Habitat—the sum total of environmental conditions of a specific place that is occupied by an organism, population, or community of plants or animals.
Habitat capability—an estimated number of animals that a habitat can sustain.
Large Woody Debris—any large piece of relatively stable woody material having a diameter of at least four inches and a length greater than three feet that intrudes into the stream channel.
Management Indicator Species (MIS)—species of vertebrates and invertebrates whose population changes are believed to best indicate the effects of land management activities.
Viable population—a population with the estimated numbers and distribution of reproductive individuals to maintain the population over time.
Wildlife Analysis Area (WAA)—divisions of land used by the Forest Service that correspond to Minor Harvest Areas used by Alaska Department of Fish and Game (ADF&G).

Affected Environment

Alaska's wildlife are valuable for aesthetic, economic, recreational, ecological, and subsistence reasons. Over 350 species of mammals, birds, amphibians, and reptiles occur on the Tongass National Forest, and most of these, except brown bear, can be found in the Upper Carroll Project Area. They occupy a diverse range of land types and plant communities, and are variably adapted to climatic extremes, change in habitat, predation, and hunting pressure.

Management Indicator Species (MIS)

Management Indicator Species (MIS) are species of vertebrates and invertebrates whose population changes are believed to best indicate the effects of land management activities (USDA Forest Service 1982). Through the MIS concept, the total number of species occurring within a Project Area is reduced to a manageable set of species that collectively represent the complex of habitats, species, and associated management concerns. The MIS are used to assess the maintenance of population viability (the ability of a population to sustain itself naturally) and biological diversity and to assess effects on species in public demand (TLMP Draft Revision 1991a).

The following have been selected as MIS for this project and will be discussed in detail in this chapter:

Species	
Rational for Selection	
Sitka black-tailed deer	Important game species
marten	Old growth; important furbearer
black bear	Represents estuarine habitat; game species
bald eagle	Old-growth coastline; high public interest
river otter	Represents riparian habitat; furbearer
hairy woodpecker	Cavity excavator
brown creeper	Represents large, high volume, old-growth trees
red squirrel	Utilization of old growth and second growth
Vancouver Canada goose	Represents riparian habitat; game species
gray wolf	Species of concern
mountain goat	Represents cliffs, alpine, subalpine, and old growth

The following species were selected as Tongass National Forest MIS, but have not been selected as MIS for the Upper Carroll project:

Species	Rationale for Nonselection
brown bear	Does not normally occur in Project Area
red-breasted sapsucker	Abundant and adaptable in Project Area

Wildlife Analysis Areas (WAAs)

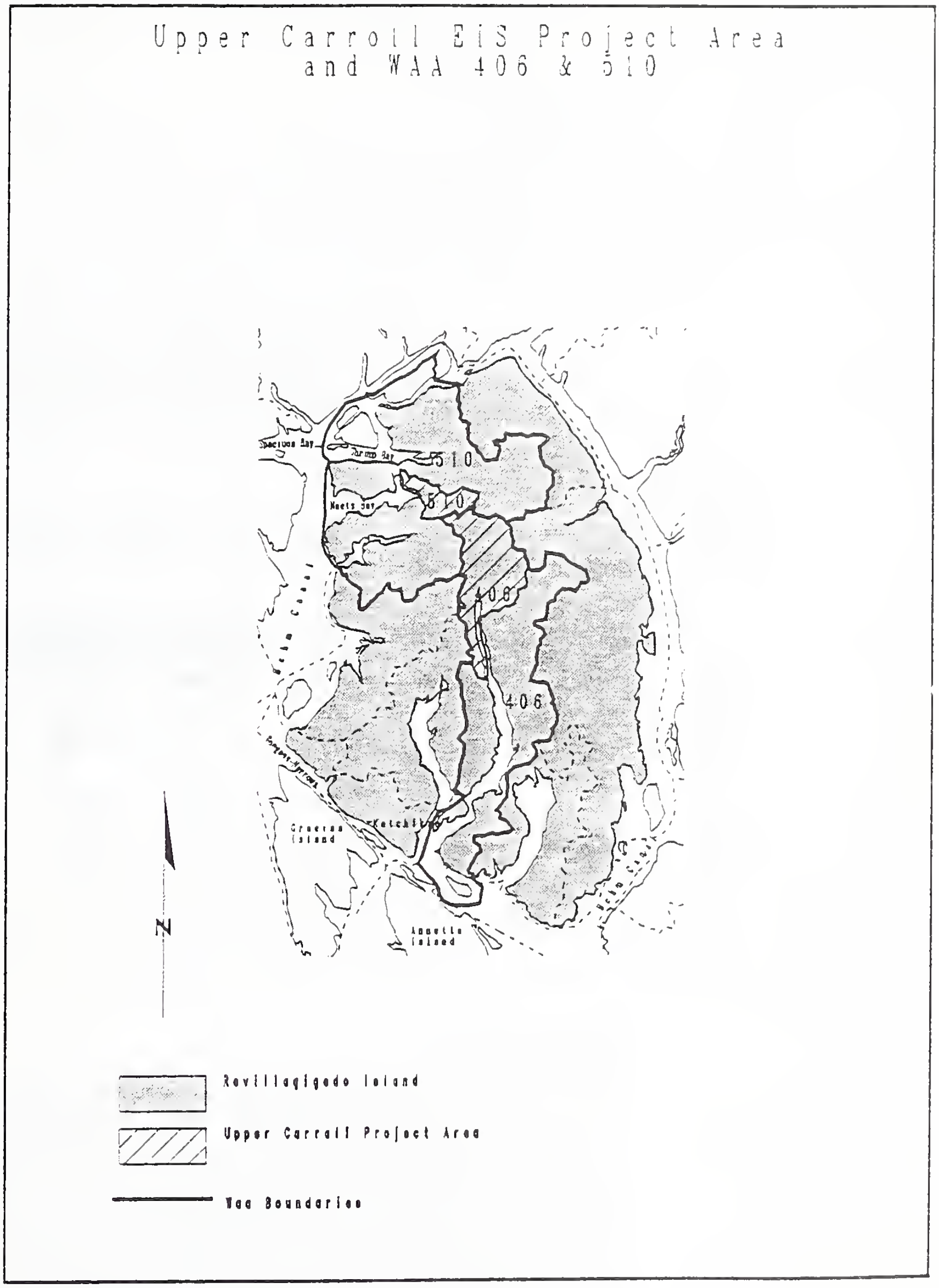
Wildlife Analysis Areas (WAAs) represent divisions of land that the Alaska Department of Fish and Game (ADF&G) uses for data collection purposes, and the Forest Service uses for wildlife analysis purposes. WAAs included in the Upper Carroll Project Area are 406 and 510 (Figure Wildlife-1). Specific VCUs that are included within Project Area WAAs are listed in Table Wildlife-1. See the Subsistence section of this chapter for a further analysis of wildlife species by WAA.

Table Wildlife-1
VCUs Within Wildlife Analysis Areas (WAAs) and Percent of the WAA that Includes the Project Area

WAA	Percent of WAA in Project Area	VCUs
406	24	746, 744
510	5	737

SOURCE: Matson 1995. Data derived from GIS data base.

Figure Wildlife-1
Wildlife Analysis Areas



Wildlife Analysis Areas (WAAs) are divisions of land identified by ADF&G and used by the USDA Forest Service for wildlife analysis.

Major Habitat Categories

The following categories are types of environment in which a species occurs. The environment can be described in physical or biological terms, which often includes elevation, topography, and type of vegetative community. A species may occupy a range of different habitats or more than one distinct kind of habitat in different seasons. Terrestrial habitats in the Upper Carroll Project Area include:

- Beach fringe
- Estuary fringe
- Riparian
- Forest
  - Old-growth forest
  - Second-growth forest
- Alpine/subalpine
- Muskeg (Peatlands)

A brief description of these habitats follows. Table Wildlife-2 displays an acreage inventory of each habitat by WAA. Note that because several categories overlap each other (e.g., beach fringe may contain some old-growth and some riparian habitats), the sum of the total acres will not be the same as the total acreage announced for the Project Area.

Table Wildlife-2
Major Habitat Categories in the Project Area, 1995 (by Wildlife Analysis Area), in Acres*

WAA	500 ft. Beach Fringe	1,000 ft. Estuary Fringe	Old-Growth Forest	Second-Growth Forest	Commercial Forest (Vol. Cl. 4-7)	Alpine Subalpine	Riparian Mgmt. Area	Muskeg
406	769	1,510	28,500	1,287	13,933	10,415	16,441	3,640
510	240	487	5,753	1,685	3,708	2,559	3,812	310
Total	**1,009**	**1,997**	**34,253**	**2,972**	**17,641**	**12,974**	**20,253**	**3,950**

* Certain use areas overlap. For example, old-growth and second-growth forest are also included in beach fringe and estuary fringe habitats.

Beach Fringe

For the purposes of this analysis, beach fringe is the land within 500 feet of the mean high tide and excludes estuarine habitats. Areas within 500 feet of the ocean shoreline are transitional zones between land and water, salt and freshwater, and vegetated and nonvegetated conditions (USDA Forest Service 1979a). Forested areas in this transitional zone are heavily used by species with high economic, recreational, subsistence, or aesthetic values. Black bear, river otter, bald eagle, marten, Sitka black-tailed deer, and Vancouver Canada goose concentrate their activities during some seasons in these forest stands. Past timber harvest activity was concentrated in this habitat. No alternatives in the Upper Carroll EIS propose any additional timber harvest within beach fringe.

Estuary Fringe

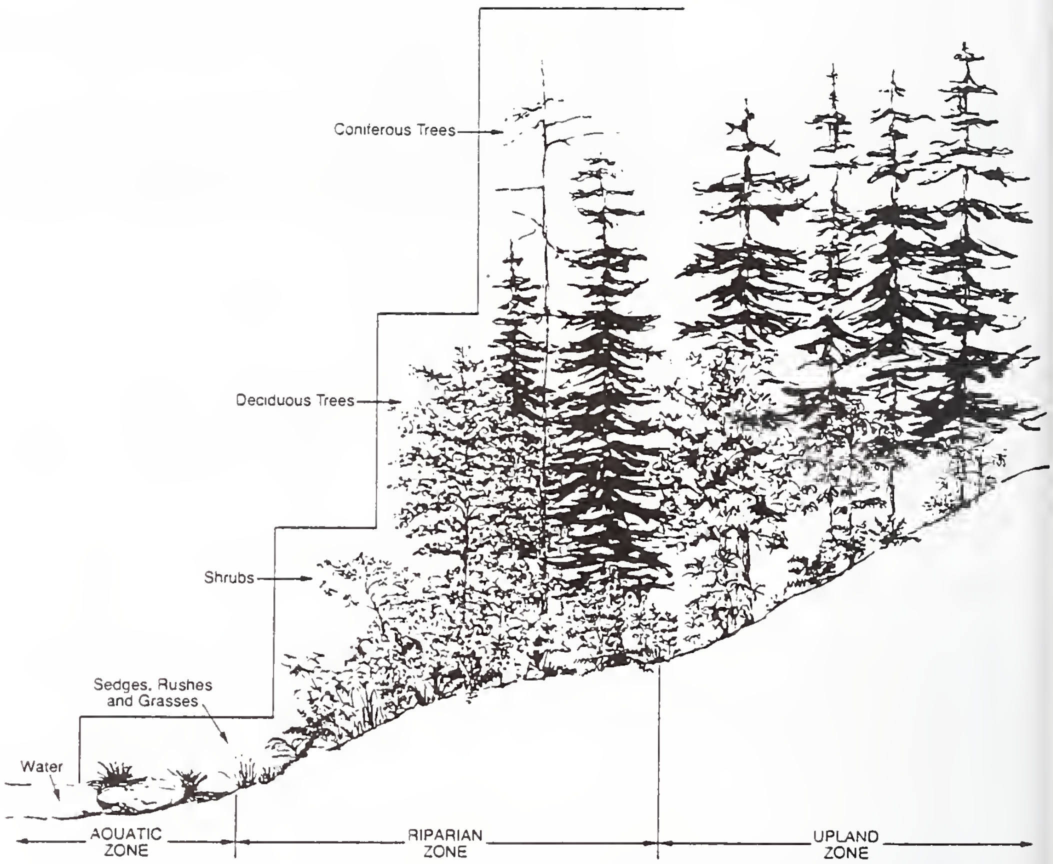
Estuary fringe habitat is a 1,000-foot zone around estuaries. Bears, waterfowl, furbearers, and eagles are the primary users of the estuary fringe habitat. The estuary fringe is similar to beach fringe, but because of species diversity, it has a greater value to wildlife, especially black bears, river otters, mink, bald eagles, and waterfowl. No harvest is proposed within the estuary fringe.

Riparian

The riparian habitat is recognized as some of the most productive wildlife habitat in Southeast Alaska. It occurs along rivers and streams or around inland lakes, and contains elements of both aquatic and terrestrial ecosystems. Many wildlife species use riparian zones to a much greater extent than other areas (USDA Forest Service 1985), and riparian habitats are extremely important for eagles, furbearers, and black bears (USDA Forest Service 1986). Riparian areas are important migration routes for some wildlife species, and serve as travel routes for numerous species because of the presence of water, food, and cover.

Alternatives described in this EIS do not propose any harvest adjacent to Class I or Class II streams or lakes larger than 5 acres, except for road construction; the width of all proposed buffer strips is at least 100 feet. For additional information see the Water Resources and Fisheries sections of this chapter.

Figure Wildlife-2
Riparian Area Characteristics



Riparian zones are transitional between aquatic and upland zones (which include forested wetlands). They provide water, food, and cover important for many wildlife species.

SOURCE: USDA Forest Service 1985.

Forest
Forest habitat includes all areas with forest cover, including old growth and second growth described below, and noncommercial forest land as described in the Silviculture and Timber section of this chapter. Many wildlife species, including those associated with old-growth stands, use all forested areas within the Project Area.

Old-growth Forest
Old-growth forest is characterized by stands of trees usually well past the age of maturity with declining growth rates and signs of decadence, such as dead and dying trees, snags, and downed woody material. The stand usually includes large diameter trees, multi-layered canopies, a range of tree diameter sizes, and the notable presence of understory vegetation. These and other characteristics make old-growth forests important habitat for Sitka black-tailed deer, martens, black bears, and cavity nesting birds such as the hairy woodpecker. These forests are in a dynamic, steady state where the death of old trees is balanced by the growth of new trees. This category of old growth also includes the unproductive forest as well as the productive commercial forest lands. Old-growth forest acres are also included in beach fringe, estuary fringe, riparian, and other habitat areas. For a more detailed discussion of old-growth vegetation, see the Silviculture, Timber, and Other Vegetation section and the Biodiversity section of this chapter.

Second-growth Forest
Second-growth forest is defined for the purposes of this section as consisting mostly of areas that have been harvested. Large-scale second-growth stands are of lower value to wildlife such as deer, martens, bears, and cavity nesters. Conifer seedlings aggressively invade and eventually shade out desirable herbaceous vegetation and provide fewer trees and snags suitable for excavation by woodpeckers and other cavity users. This habitat type was inventoried to help display the amount of past timber harvest activity that has occurred within the Upper Carroll Project Area. Some second-growth forest has been created naturally by windthrow, landslides, and avalanches.

Alpine/Subalpine
The alpine/subalpine category includes all sites at or above treeline, including open meadows of grasses, forbs, and shrubs; and scrub forest (Sidle and Suring 1986). Subalpine habitat includes a mosaic of forested, scrub, and nonforested sites that occur at higher elevation than the upland forest, at the lower edge of the alpine zone (Sidle and Suring 1986). Alpine/subalpine habitat within the Upper Carroll Project Area is generally above 2,000 feet in elevation. These habitats are important summer foraging areas for deer and black bears.

Muskeg (Peatlands)
Muskegs are most often characterized by stunted yellowcedar and shore pine, along with sedges and other bog vegetation. Muskegs dominated by sphagnum moss or tall sedge cover smaller areas. The water table is at the surface, and numerous small ponds are scattered throughout the muskeg.

Wildlife Habitat Capability Models

Wildlife models were used to calculate habitat capability for each MIS in the Project Area. For specific information on the models used, see Suring (1993). Because of the amount of timber harvest on non-National Forest System lands throughout the Ketchikan Administrative Area, a maximum potential impact was assumed, and no habitat capability was calculated for State, private, or encumbered lands. There are 1,573 acres of unconveyed State Selection land within the 47,942 acre Project Area (see the Planning Record). Encumbered lands are less than four percent of the Project Area.

The terms "habitat capability" and "populations" are not interchangeable. Habitat capability is synonymous with carrying capacity or the estimated number of animals the habitat can support through the most critical period of the year. Population is the estimated number of animals actually present at a given time. Populations may temporarily exceed habitat capability (for example, due to a series of mild winters). However, populations may be below what the habitat is capable of producing, due to predation, winter mortality, or other ecological factors in some years.

Given data limitations, the complexity of ecological relationships, and the need to simplify variables for use in the models, actual population sizes in some areas may vary considerably from those predicted by the analysis. However, the procedures provide estimates of habitat capability that over time are expected to be a reasonable indicator of relative potential impacts and population trends as they relate to the amount and quality of habitat only. Actual populations at any given point in time can be greatly influenced by weather, hunting, trapping, disease, predation, and related factors. Table Wildlife-3 estimates the 1954 and the current wildlife habitat capability in the Project Area.

Table Wildlife-3
Wildlife Habitat Capability within the Upper Carroll Project Area

Selected MIS	1954*	1995*	Percent Change
Sitka black-tailed deer**	629	389	-38
marten**	50	45	-10
black bear	74	70	- 5
bald eagle	54	40	-26
river otter	21	17	-19
red squirrel**	24,637	22,714	- 8
hairy woodpecker**	501	341	-32
brown creeper**	993	497	-50
Vancouver Canada goose	86	74	-14
gray wolf	1.8	1.1	-40

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability models.

* Habitat capability for just the portion of WAAs in the Project Area.
** Patch-size effectiveness calculations are displayed in the Biodiversity section

Sitka Black-tailed Deer

The Sitka black-tailed deer was chosen as an MIS because it is an important game and subsistence species and is seasonally associated with old-growth forests.

Historically, population fluctuations of Sitka black-tailed deer in Southeast Alaska have been linked with winter severity (Merrian 1970) and predation pressure (Van Ballenberge and Hanley 1984). Deep snow and late springs associated with severe winters have occurred several times in the past 80 years. Deer die-offs are common during severe winters, even in the best old-growth winter ranges. Predators of deer, such as gray wolves, bears, and hunters, can also contribute to the population decline during these winters, inhibiting subsequent recovery of the deer population. In general, winter severity increases with latitude and with a decreased maritime influence in Southeast Alaska (Longhurst and Robinette 1981); within the Project Area, VCUs 737 and 744 have deep snow depth ratings, and VCU 746 has a moderate snow-depth rating.

Research conducted throughout Southeast Alaska indicates that high volume, old-growth forests at lower elevations are essential to maintaining a sustainable deer population during severe winters (Schoen et al. 1985; Hanley and Rose 1987; Yeo and Peek 1992). Large, strong branches, characteristics of the old-growth stands, intercept snow, providing for deer mobility while maintaining available forage. High volume stands of old-growth forests support adequate herb and shrub layers of deer forage. In most cases, timber harvest of deer winter range reduces the long-term quality of deer winter range. Effects on deer populations are compounded by the combination of deep-snow winters and large amounts of deer winter range converted to second growth. Snow significantly reduces forage availability in clearcuts during the winter. Closed canopy second-growth stands provide little forage in winter or summer. The amount of second growth and winter severity are key factors in determining the capability of the land to support deer populations.

An interagency model (Suring et al. 1991) was developed to evaluate the potential quality of winter habitat for Sitka black-tailed deer. Winter is assumed to be the most limiting season for the Sitka black-tailed deer throughout the area (Hanley and McKendrick 1985, cited by Suring et al. 1991). The deer model incorporated the following factors in the analysis: (1) snow conditions, (2) presence of predators, (3) physiographic features including aspect and elevation, (4) patch size, and (5) vegetational characteristics including: (a) volume class of old growth, (b) forest type, (c) second growth (25 to 150 years), and (d) clearcut (0 to 25 years).

Results of the deer model indicates there is a habitat capability for approximately 389 deer in the Upper Carroll Project Area (Table Wildlife-3). This represents a 38 percent reduction in habitat capability since the start of the KPC contract in 1954 because of past timber harvest. Table Wildlife-4 shows habitat capability by WAA at current conditions and before 1954.

Table Wildlife-4
ADF&G Population Objectives and Deer Habitat Capability by WAA for 1954 and 1995 in the Upper Carroll Project Area and for the Entire WAA

		1954 Habitat Capability		1995 Habitat Capability		Percent Change	
WAA	ADF&G Population Objectives	Project Area	Entire WAA	Project Area	Entire WAA	Project Area	Entire WAA
406	2,202	426*	2,937	339*	2,659	-20*	-10
510	1,947	203*	2,652	50*	1,849**	-75*	-30
Total	**4,149**	**629***	**5,589**	**389***	**4,508**	**-38***	**-19**

SOURCE: Burns 1996. Data derived from GIS data base and Sitka black-tailed Deer Habitat Capability Model, Suring et al., 1992.

* Numbers do not incorporate patch-size effectiveness calculations.
** Takes into account the loss of deer habitat capability as a result of implementing North Revilla EIS.

Two of the three VCUs that make up the Upper Carroll Project Area are rated as "deep snow" which results in a lower deer habitat capability. The Upper Carroll Project Area is mostly poor deer habitat, primarily because of high elevation, deep snow, and lack of forest cover. This corresponds with what was observed during field reconnaissance. Field crews reported very little deer sign in the inland reaches of Carroll Creek. Most of the best deer habitat is in the low elevation areas around the Carroll Creek where it flows into Carroll Inlet.

The Carroll River drainage is located near the center of Revillagigedo Island and is connected to other valleys by low passes. Low passes connect to Neets Creek and Orchard Creek valleys to the north, and Traitors Creek to the east. Passes also connect to the Naha drainage to the east and Misty Fiords National Monument to the west. These features suggest that the Carroll Creek valley may serve as a crossroads for wildlife dispersal between the east and west halves of Revillagigedo Island.

Deer Population Objectives

The ADF&G has established deer population objectives for all WAAs in Southeast Alaska for the years 1991-1995. The population objectives for the individual WAAs can be found in ``Population Objectives–Strategic Plan for Management of Deer in Southeastern Alaska 1991-95'' (ADF&G 1991).

Deer population objectives for the WAAs range from maintaining deer habitat at 100 percent of the 1954 level, to 75 percent of the 1954 level. The existing habitat capability for deer in WAA 406 is well above ADF&G population objectives. The population objective for WAA 510 has been set at the current habitat capability (due to past timber harvest activity). With implementation of the adjacent North Revilla EIS, deer habitat capability will fall below ADF&G Population Objectives (see Table Wildlife-4), which means that any additional timber harvest activity will further reduce the habitat capability of WAA 510 below ADF&G population objectives (see Table Subsistence-13 in the Subsistence Section). A complete analysis of how projected Forest-wide timber harvest levels affect deer habitat capability compared to the ADF&G population objectives can be found in the TLMP Draft Revision (1991a).

Marten

The marten was selected as an MIS to represent old-growth associated species and because it is an important furbearer. Marten populations are moderate in the Project Area. Trapping pressure is moderate from residents of Neets Bay and the Ketchikan Area. High pelt prices, susceptibility to trapping pressure, and liberal trapping regulations have created a large demand for marten.

Martens prefer mature old-growth forests with a well developed overhead canopy. Snags and downed woody debris are important to martens for winter and summer dens and resting sites and cover habitat for prey species. The distribution and abundance of martens is determined to a large extent by the availability of cover and the presence of prey species (Simon 1980).

Throughout the year, especially in the winter, small mammals are an important food source for martens. During the summer their diet is supplemented by birds, insects, fruits, and berries.

The model was developed to evaluate the potential quality of winter habitat for the marten (Suring et al. 1988a). The underlying assumption is that if adequate winter habitat is available, habitat requirements throughout the rest of the year will not be limited. The model incorporated the following factors in the analysis: (1) classes of timber volume in old-growth forests, (2) stand size classes [stand age], (3) beach fringe habitat, (4) riparian habitat, (5) elevation, and (6) old-growth patch size.

The marten model (with patch-size effectiveness taken into consideration) indicates there is habitat capability for an estimated 45 martens in the Upper Carroll Project Area (Table Wildlife-3). This 10 percent decline from the 1954 habitat capability is due to past harvest activity.

Black Bear

The black bear was selected as an MIS to represent estuarine habitat and because it is an important game species. Black bears occur throughout the Project Area, and populations are currently stable. As of the 1990/91 black bear harvest season, nonresident hunters have been limited to one black bear, while Alaska residents may harvest two black bear.

Black bears are highly adaptable and can tolerate moderate disturbances, such as habitat alteration, as long as the basic requirements for food and cover are satisfied (Lawrence 1979). As clearcut stands mature, both forage resources and numbers of denning sites may decline.

After emergence from dens in the spring, black bears seek sources of new plant growth for food (Mondafferi 1982). Grass flats of estuaries, low elevation forests near the beach (beach fringe habitats), and avalanche slopes provide the needed high quality forage. The Carroll Inlet estuary receives heavy spring and summer bear use. During the summer, black bears feed on forbs, berries, and salmon. In the fall they feed on berries and forbs (Sidle and Suring 1986) in the subalpine areas.

Bear den sites include: (1) cavities in trees and stumps, (2) caves, and (3) excavated and natural depressions under tree roots, stumps, and fallen logs. Black bears search for food in clearcuts that provide access to cover, which is found in mature and old-growth forests. Clearcuts 10 to 15 years old are preferred because of the production of large amounts of berries (Lindzey and Menslow 1977).

Field inventories found high concentrations of black bear around the estuary at the head of Carroll Inlet. Bear sign was observed frequently throughout the Carroll River drainage.

The model for black bears incorporated the following factors in the analysis: (1) the average annual value of upland habitats, (2) the average annual value of riparian habitats and potential salmon production, and (3) the average annual value of beach fringe habitats. (For more information regarding the model see: Suring et al. 1988b.)

The black bear model indicates there is habitat capability for an estimated 70 black bears in the Upper Carroll Project Area (Table Wildlife-3). This is a five percent decline from the pre-1954 habitat capability.

Bald Eagle

The bald eagle was selected as an MIS because the public has a strong interest in the species and the species has special habitat requirements. Bald eagle habitat is defined as beach fringe habitat. The majority of eagles in Southeast Alaska nest in coniferous forest habitats along the coastline and associated saltwater inlets (Suring et al. 1988c). Eagles prefer to nest in continuous stands of old growth rather than in narrow leave strips of old-growth trees. Of the 3,850 nests surveyed in Southeast Alaska, 92 percent were within 300 feet of the shoreline (Hodges and Robards 1982).

Bald eagles nest adjacent to the habitat that provide the best opportunities for foraging or searching for food, such as over open water and on tidal flats. Eagles primarily feed on fish, but are also known to feed on waterbirds, marine invertebrates, and drifting carrion. Perching sites near the nest and foraging areas are also important components of bald eagle habitat. The bald eagle and its habitat have been given special protection through the Bald Eagle Protection Act as implemented by an Interagency Agreement between the Forest Service and the U.S. Fish and Wildlife Service (USDA Forest Service and USDI Fish and Wildlife Service 1990). Among the provisions of the Interagency Agreement are: requirement of a 330-foot vegetation protection buffer around eagle nests, timing restrictions for blasting within one-half mile of known nests, and a requirement that formal consultation with the U.S. Fish and Wildlife Service take place when any portion of the agreement cannot be implemented. The U.S. Fish and Wildlife Service has identified two nest sites in the Upper Carroll Project Area. During field inventories, a third nest was found on the west side of Carroll Inlet across from the Swan Lake power plant. A high amount of eagle activity was observed at the Carroll Creek estuary, but no nests were found there. Table Wildlife-5 displays the number of identified eagle nests which occur in each WAA.

Table Wildlife-5
Number of Eagle Nests by WAA

WAA	# Nests
406	3
510	0
Total	3

SOURCE: Burns 1996. Data derived from GIS data base.

The model evaluated only the nesting habitat of bald eagles because limited information is available on the winter habitats and movements of bald eagles in Southeast Alaska (Suring et al. 1988c). The model considered the following factors in the analysis: (1) old-growth forest, (2) volume class, (3) distance from shore, and (4) elevation of riparian habitat.

The model indicates there is nesting habitat capability for an estimated 40 eagles (Table Wildlife-3). This is a 26 percent decline from the pre-1954 habitat capability. Some evidence exists that food may be the most limiting factor, not nest sites (TLMP Draft Revision 1991a).

River Otter

The river otter was selected as an MIS to represent riparian habitats and because it is an important furbearer. River otters concentrate along intertidal zones and the adjacent narrow beach fringe. They also travel extensively throughout streamside habitats. The old-growth forests in Southeast Alaska are assumed to provide optimum habitat for river otters (Suring et al. 1988d), with seedling and sapling (i.e. clearcut) and pole timber stands providing limited habitat. Otters avoid clearcuts extending to the beach in Southeast Alaska (Larsen 1983) because of lack of cover and density of shrub growth. High value otter habitat must provide adequate shelter in addition to sufficient food (Melquist and Hornocker 1983). River otters feed on fish (primarily sculpins and rockfish), crabs, and occasional invertebrates other than crabs (Sidle and Suring 1986).

River otters depend on large woody debris (LWD) in streamside, lakeside, and beach habitats. The large extensive root systems, downed tree trunks, and overturned root wads of old-growth trees create undercuts and hollows that maintain den and resting sites, and cover. From May through July, female otters use old-growth habitats near streams for inland dens (up to 0.5 miles from the coastline). The annual harvest of river otter on the Tongass National Forest has varied from a high in 1979-80 of 652 animals, to a low of 373 animals in the 1986-87 harvest season. Harvest numbers are a function of both otter abundance and trapper effort.

Habitat capability for this species was determined for spring (May through July) because river otters make use of all occupied habitats at this time of year (Suring et al. 1988d). The model incorporated the following factors in the analysis: (1) distance from saltwater, (2) beach, (3) estuary, (4) elevation of riparian habitat, (5) volume class, (6) stream class, and (7) lake size.

The model indicates there is habitat capability for an estimated 17 otters (Table Wildlife-3) in the Upper Carroll Project Area. This is a 19 percent decline in habitat capability from the pre-1954 habitat capability.

Red Squirrel

Optimum habitat for red squirrels provides opportunities for food sources, food caching sites, and nesting cover (Vahle and Patton 1983). This includes forested stands with two or more species of conifers of cone-bearing age for food, snags for den sites, and downed logs for cache sites. These conditions are best provided in old-growth Sitka spruce forests in Southeast Alaska. Other forest types provide life requirements of red squirrels, but food resources are not as plentiful as they are in spruce forests. Red squirrels represent a species that can survive fairly well in second-growth timber stands at seed-producing age. The red squirrel model evaluates habitat capability based on elevation and vegetation.

In the Upper Carroll Project Area, the model indicates there is habitat capability for an estimated 22,714 red squirrels (Table Wildlife-3). This is an eight percent decline in habitat capability since 1954.

Hairy Woodpecker

The hairy woodpecker was chosen as an MIS representing cavity users because of its preference for stands of old-growth western hemlock and Sitka spruce, and for its association with snags (standing dead trees). Hairy woodpeckers are year-round residents in Southeast Alaska and use snags and partially dead trees for nesting and foraging. These woodpeckers feed on larvae of wood-boring beetles, other insects, and seeds and berries in winter (Sidle and Suring 1986).

The hairy woodpecker is important as a primary cavity excavator because by drilling holes in trees it creates habitat needed for other wildlife species (Kesseler 1979; Noble and Harrington 1977). Forty-two species of mammals and birds in Southeast Alaska nest or den in tree cavities, including woodpeckers, owls, hawks, waterfowl, bats, squirrels, martens, and otters. Several of these species depend exclusively on cavities in the large diameter snags characteristic of old-growth stands for nest and den sites. Most cavity nesting or denning species would be represented by hairy woodpeckers and respond similarly to proposed activities.

Hairy woodpecker habitat is defined as Volume Class 4 through 7 stands below the subalpine category. Availability of suitable winter habitat for roosting and foraging is considered an important constraint on the habitat suitability of the hairy woodpecker. The model (Suring et al. 1988e) incorporates the following factors in the analysis: (1) old-growth forests, (2) volume class, and (3) old-growth patch size.

The model indicates there is habitat capability in the Upper Carroll Project Area for an estimated 341 hairy woodpeckers (Table Wildlife-3). This is a 32 percent decline from the pre-1954 habitat capability.

Brown Creeper

The brown creeper was chosen as an MIS because it is associated with large, old-age trees and represents the old-growth forest community. Brown creepers and other bark foraging birds also select larger diameter trees as foraging sites during cold, windy weather to lessen their exposure (Grubb 1975, Webber 1986). The diet of brown creepers consists of larvae, pupae, and eggs of insects gleaned from the crevices of bark, spiders, other small invertebrates, and occasionally seeds (Pearson 1923, Reilly 1968). Large diameter trees are preferred because a bird can feed longer on a large tree and capture more prey per visit (Airola and Barrett 1985).

The abundance of large coarse-barked trees and the length of the vertical foraging height appears to affect the territory size (Apfelbaum and Hanley 1977); the area necessary to support the birds increases as the number of large, tall trees decreases. Brown creepers spend most of their time foraging on live parts of trees rather than dead trees (Morrison et al. 1987).

Brown creeper habitat is defined as Volume Class 6 and 7. Slightly more than one tenth of the number of brown creepers observed in stands with 30,000 board feet per acre were observed in stands with 20-30,000 board feet per acre (i.e., Volume Class 5) (Hughes 1985). Other habitats in Southeast Alaska were not considered to provide suitable habitat for brown creepers.

The model indicates there is habitat capability in the Upper Carroll Project Area for an estimated 497 brown creepers (Table Wildlife-3). This is a 50 percent decline from the pre-1954 habitat capability.

Vancouver Canada Goose

The Vancouver Canada goose was selected as an MIS to represent old-growth and riparian habitats. The Vancouver Canada goose is also a game species.

Banding studies have indicated Vancouver Canada geese are primarily nonmigratory (Ratti and Timm 1979) and are found almost exclusively in Southeast Alaska. These geese use forested habitats for nesting and brood rearing; they place nests in trees, use trees for perches during incubation, and rely primarily on forest understory plant species for food during this part of their life cycle (Doyle et al. 1988). Lebeda and Ratti (1983) suggest that the three most important factors for nesting Vancouver Canada geese are: (1) dense understory vegetation, (2) forest surrounding surface water, and (3) an abundant food source.

Nesting geese have been observed at the Carroll Creek estuary. This is also an important wintering area for geese and other waterfowl, including trumpeter swans. Up to 200 geese have been reported at the estuary at times.

For analysis of effects on Vancouver Canada geese, the model developed by Doyle et al. (1988), *Habitat Capability Model for Vancouver Canada Goose in Southeast Alaska—Nesting and Brood Rearing Habitat*, was used. This model only considered those habitats within 2,600 feet of uncontained river channels, lakes, or salt water as being suitable for Vancouver Canada geese.

The model indicates there is habitat capability in the Upper Carroll Project Area for an estimated 74 Canada geese (Table Wildlife-3). This is a 14 percent decline from the pre-1954 habitat capability.

Gray Wolf

The gray wolf was selected as an MIS because of public concerns over what effects additional timber harvest and higher road densities would have on the wolf population within the Upper Carroll Project Area. Wolves have been heard howling in the Carroll River valley. Observed wolf sign has been mostly concentrated in the lower part of the valley near the estuary. Pack home range and numbers are not known.

Gray wolves do not exhibit a preference for specific habitats or habitat characteristics (Paradiso and Nowak 1982). The presence and well being of gray wolves appears to be dependant on the availability of prey rather than landform, climate, or vegetation.

A review of the population dynamics of gray wolves demonstrated that rates of increases are primarily determined by the availability of deer and other ungulate prey (Keith 1983). Packard and Mech (1980) concluded that intrinsic social factors and the influence of the food supply are interrelated in determining population levels of gray wolves. It has been demonstrated that predation by gray wolves sustains declines in ungulate populations that have been initiated by other factors (e.g., severe weather, habitat changes) (Mech and Karns 1977, Nelson and Mech 1981, Gasaway et al. 1983, Van Ballenberghe and Hanley 1984, Smith et al. 1986).

Prey species available to gray wolves in Southeast Alaska include Sitka black-tailed deer, moose, mountain goat, beaver, and spawning salmon. Of these species, deer, beaver, and spawning salmon are the primary prey in the Upper Carroll Project Area.

The habitat capability model developed for wolf primarily runs off the habitat capability model outputs of the deer, moose, and mountain goat models. The gray wolf habitat capability model estimates the Upper Carroll Project Area can support approximately 1.1 wolves (Table Wildlife-3). This is a 40 percent reduction from the pre-1954 habitat capability.

Mountain Goat

Mountain goats represent species using cliffs, alpine and subalpine, and old-growth forest habitats. Hunted populations are sensitive to overharvest and human disturbance. The quality and quantity of winter habitat is the most limiting factor for mountain goats in Southeast Alaska. Old-growth trees with large dense crowns have the highest value because they intercept the most snow and provide understory forage plants. Lack of snow interception in early successional stages, and lack of forage in middle successional stages, reduces their value as habitat (TLMP RSDEIS, 1996a).

Mountain goats have been introduced onto Revilla Island over the past 15 years. A substantial population now exists near Mount Reid, just east of the Project Area. The population ranges from the ridge above Swan Lake north to the ridge above Orchard Lake.

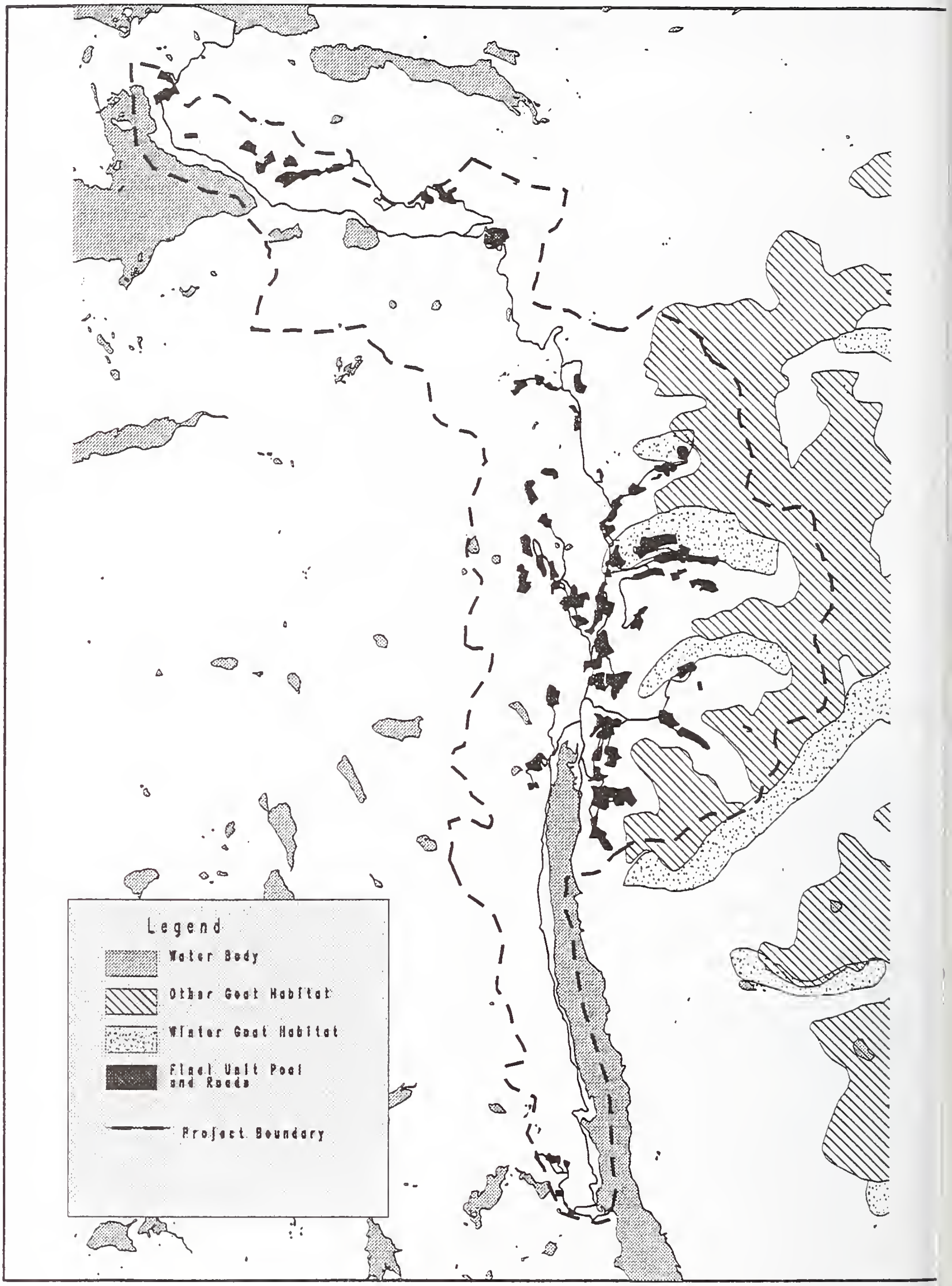
Suring, et al. (1988f) identified productive old growth near escape terrain as the most important winter habitat. The primary factors in evaluating goat habitat is availability of food and its proximity to escape terrain.

Potential winter habitat for mountain goats was identified through consultation with Alaska Department of Fish and Game biologists. According to ADF&G, the areas most likely used as winter habitat within the Upper Carroll Project are the south facing slopes along the Carroll River tributaries that are located west of Mount Reid (Figure Wildlife-3). The south facing slope in the Swan Lake drainage also provides important winter habitat. Similar drainages to the east of Mount Reid in Misty Fiords National Monument also provide winter habitat.

The goats are concentrated around Mount Reid. The valley west of Mount Reid (which contains units 16, 66, and 67) contains possibly the highest value habitat for goats on Mount Reid due to the fact that it is located so close to the highest concentration of goats. Other patches of winter habitat, including winter habitat east of Mount Reid in Misty Fjords National Monument, are farther away from Mount Reid and are of lesser value to goats on Mount Reid.

A total of approximately 39,576 acres were identified as mountain goat summer habitat. This habitat is generally located on steep slopes at or above tree line, which provides escape terrain and summer forage. Winter habitat was identified as old-growth forest habitat in close proximity to steep cliffs and steep, rocky slopes that provide escape terrain. A total of 11,127 acres were identified as goat winter habitat. This includes areas in Misty Fiords National Monument as well as the Swan Lake drainage and Upper Carroll Project Area. Approximately 2,044 acres are located in the Upper Carroll Project Area.

Figure Wildlife-3
Mountain Goat Habitat for Upper Carroll Project Area



Effects of the Alternatives

This analysis considers the direct, indirect, and cumulative effects of timber management in the Project Area. Direct effects are projected to 1997, the anticipated end of the current proposed action; to 2004, which includes the reasonably foreseeable future and the end of the KPC long term sale contract; to 2040, to show the cumulative impacts of past and proposed timber harvest; and to 2140, to show the cumulative impacts of harvesting all the suitable lands through the first rotation and halfway through the second.

Direct and Indirect Effects

Comparison of Alternatives: Effects on Wildlife Habitat

Each action alternative includes harvest of wildlife habitat. Project unit design criteria, BMPs (FSH 2509.22, 1991), and/or legislated protective measures (TTRA) and Forest Standards and Guidelines significantly reduce or eliminate potential impacts to beach fringe, estuary fringe, and riparian habitats in each alternative. Alpine/subalpine habitat is also affected slightly (less than 32 acres) by road and unit location because of inaccessibility and/or low productivity. Changes throughout the Project Area in these habitats are 1 percent or less for each alternative (Table Wildlife-6). Impacts to MIS that depend on these habitats are low. Alternative 1, the no-action alternative, will harvest no acreage, with the effect that existing wildlife habitats will remain at current levels, with changes over time due only to natural succession or future timber harvest.

Table Wildlife-6 displays the percent change in wildlife habitats as a result of timber harvest.

Table Wildlife-6
Proposed Acres for Harvest and Percent Change from 1954 in Wildlife Habitats by Alternative

			Alt. 1		Alt. 2		Alt. 3		Alt. 5		Alt. 6		Alt. 7	
Habitat Categories	1954 Acres	Existing Acres	Acres Cut	% Chg	Acres Cut	% Chg	Acres Cut	% Chg	Acres Cut	% Chg	Acres Cut	% Chg	Acres Cut	% Chg
Beach Fringe	1,009	1,009	0	0	0	0	0	0	0	0	0	0	0	0
Estuary Fringe	1,997	1,997	0	0	0	0	0	0	0	0	0	0	0	0
Riparian	30,100	30,100	0	0	335	- 1	183	- <1	314	- 1	223	-< 1	88	- <1
Old-Growth Vol. Class 4-7	18,214	17,641	0	0	1,778	-10	951	- 5	1,453	- 8	912	-5	504	-3
Alpine/Subalp.	12,974	12,974	0	0	32	-<1	0.5	-<1	19	-<1	0	0	0	0

SOURCE: Burns 1996. Data derived from GIS data base.

Beach Fringe
None of the alternatives propose any timber harvest within the 500-foot beach fringe zone.

Estuary Fringe
None of the alternatives were designed to harvest timber within the 1,000-foot estuary fringe zone. GIS analysis revealed that some slivers of units did extend into the estuary fringe. These units were trimmed or eliminated to conform to the estuary boundary between draft and final EIS.

Riparian
For the purpose of this analysis, riparian habitat was identified by using riparian soils and the Riparian Area Prescriptions as shown in Appendix C. TTRA buffers, or 100-foot minimum buffers around lakes larger than five acres, are not proposed for harvest.

Old-growth Forest
Old-growth forest comprises 34,252 acres of which 17,641 acres is commercial forest in the Project Area. Within some harvest units are scattered patches of nonforested or low productivity forest types. The biggest difference among the alternatives is the total number of acres scheduled for harvest for each particular alternative. Alternative 2 proposes to harvest 10 percent of the existing commercial old-growth forest. Alternatives 3, 5, 6, and 7 propose to harvest from three to eight percent. The effects of old-growth habitat loss on old-growth associated species are reflected in Habitat Capability for MIS later in this section. For a discussion of the amount of timber harvest by volume class, see the Silviculture, Timber, and Other Vegetation section of this chapter.

Alpine/Subalpine
All of the action alternatives propose a minor amount of timber harvest (1 to 32 acres) in the subalpine habitat.

Comparison of Alternatives: Effects on Habitat Capability
The previous section discusses changes to wildlife habitats used by the MIS. This section discusses how those changes in habitats affect the potential habitat capability for each MIS. As mentioned in the Affected Environment earlier in this section, the models that estimate the capability of habitats to support selected species are not necessarily accurate reflections of actual populations in the Project Area. Actual population levels are not known for a given period in time and probably never will be due to weather, hunting/trapping, disease, predation, and other related factors which are difficult or impossible to predict for any given time in the future.

Several MIS show a habitat/use relationship with the size of preferred habitats. The wildlife models for this analysis take into account those patch-size relationships for Sitka black-tailed deer, marten, and hairy woodpecker. Direct impacts to black bears, otters, and bald eagles have been greatly reduced in all action alternatives through avoidance of timber harvest in beach fringe, estuary fringe, stream corridors, riparian, and alpine/subalpine habitats.

Alternative 1 would have no direct effect on habitat capabilities for any MIS. Tables Wildlife-7 through Wildlife-17 display the changes in habitat capabilities, measured against Alternative 1, that would occur under Alternatives 2 through 5.

Sitka Black-tailed Deer

Sitka black-tailed deer are dependent on low elevation, high volume, old-growth stands during severe winters, and are affected by proposed timber harvest under the action alternatives. Alternative 2 would decrease habitat capability 8 percent in the Project Area while Alternatives 3, 5, 6, and 7 would decrease habitat capability from three to six percent (see Table Wildlife-7).

Second-growth canopy closure in timber stands 20 to 30 years after harvest may be delayed by thinning to promote forage production (Hanley et al. 1989). Second-growth forest management has been widely used in Southeast Alaska, but recent research has not documented benefits to Sitka black-tailed deer from thinning and canopy gaps. Potential areas for thinning are listed in Appendix I.

Table Wildlife-7
Changes in Habitat Capability for Deer to Year 1997

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability*	389	357	371	364	367	376
Change in Capability	0	- 32	- 18	-25	- 22	- 13
Percent Change	0	- 8	-5	-6	-6	-3

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

* Numbers do not incorporate Patch-size Effectiveness calculations.
Note: Habitat capability figures assume the value of zero for units immediately following harvest.

At first glance, Table Wildlife-7 appears to underestimate the impacts to deer winter habitat. A reduction in habitat capability of only 32 deer from harvesting almost 2,000 acres seems low. The figures were checked by hand for accuracy. The relatively low loss of habitat capability is due to the fact that relatively few units are located in high value deer winter habitat. Much of the high and moderate value winter habitat was removed during previous timber harvest operations which harvested much of the habitat at low elevations in Carroll Creek and in Neets Bay. This is shown in Table Wildlife-4 as a relatively high amount of habitat capability was lost between 1954 and 1995.

The units in the Upper Carroll project mainly harvest units on higher elevations and north or west facing slopes, thereby avoiding most of the remaining high value deer winter habitat. This is reflected in Table Wildlife-8. Eighty percent of the harvest will occur in habitat of low or no value (according to the model) and three percent is located in high value habitat.

Table Wildlife-8
Harvest of Deer Habitat Capability, by Habitat Suitability Index in Acres

Habitat Suitability Index	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
0 (none)	0	354	144	266	92	19
1-20 (low)	0	1,235	667	940	593	336
21-42 (medium)	0	345	242	364	308	208
43 + (high)	0	62	43	48	39	28
Total Acres	**0**	**1,996**	**1,096**	**1,618**	**1,032**	**591**

SOURCE: Burns 1996. Data derived from GIS data base.

Black Bear

Avoidance of beach fringe, estuary fringe, stream corridors, and riparian habitat with timber harvest is reflected in a less than six percent decline in black bear habitat capability for all action alternatives. Alternative 2 harvests the most bear habitat, and would harvest habitat capable of supporting an estimated four black bear (Table Wildlife-9). Alternative 7 reduces the habitat capability for bear by two bears (three percent), which is the lowest reduction of habitat capability of all the action alternatives .

Table Wildlife-9
Changes in Habitat Capability for Black Bear to Year 1997

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability	70	66	67	67	67	68
Change in Capability	0	-4	-3	-3	-3	-2
Percent Change	0	-6	-4	-4	-4	-3

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

Marten

The marten is an old-growth associated species that uses a wide range of old-growth volume classes, tree species, and landscape zones. Alternatives 2 would harvest habitat capable of supporting an estimated five martens, for an 11 percent decline in habitat capability. Alternatives 3 and 6 would decrease habitat capability by three (see Table Wildlife-10). Alternatives 5 and 7 would decrease habitat capability by four and two respectively. Martens are easily trapped and can be overharvested, especially where trapping pressure is heavy (Strickland, et al., 1982) and not effectively controlled. Without an access management plan to keep open accessible road densities to less than 0.5 miles of road per square mile, there could be an additional 85 percent reduction in population levels due to trapping (Suring et al. 1988). Trapping impacts are expected to be minimal due to limited access. Road management objectives have been developed for the Project Area and can be found in Appendix K.

Table Wildlife-10
Changes in Habitat Capability for Marten to Year 1997*

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability**	45	40	42	41	42	43
Change in Capability	0	- 5	- 3	-4	- 3	-2
Percent Change	0	- 11	- 7	-9	- 7	-4

SOURCE: Burns 1996. Data derived from GIS database and interagency habitat capability model.

* Without road density effects.
** Numbers do not incorporated patch-size effectiveness calculations.

River Otter

The otter is another species that benefited from measures taken during unit design which limited timber harvest in beach fringe, estuary fringe, stream corridors, and riparian habitat. Alternatives 2 through 7 would harvest habitat capable of supporting an estimated one otter (Table Wildlife-11).

Table Wildlife-11
Changes in Habitat Capability for River Otter to Year 1997

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability	17	16	16	16	16	16
Changes in Capability	0	-1	-1	-1	-1	-1
Percent Change	0	-6	-6	-6	-6	-6

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

Red Squirrel

The red squirrel is most successful in old-growth stands. Changes in habitat capability under the action alternatives range from two to seven percent (Table Wildlife-12).

Table Wildlife-12
Changes in Habitat Capability for Red Squirrel to Year 1997

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability	22,714	21,226	21,890	21,554	21,855	22,178
Changes in Capability	0	-1,488	- 824	1,160	- 856	-536
Percent Change	0	- 7	- 4	-5	- 4	- 2

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

Hairy Woodpecker

The hairy woodpecker is a primary excavator that prefers high volume, old-growth timber, but can also effectively use lower volume stands. Alternative 2 would decrease habitat capability 11 percent in the Project Area; Alternatives 3, 5, 6 and 7 would decrease habitat capability by a range of five to nine percent (Table Wildlife-13). Hairy woodpeckers may also benefit from snag retention in clearcuts as a mitigation of timber harvest (see Snag Abundance Analysis in this section and Chapter 2 Mitigation).

Table Wildlife-13
Changes in Habitat Capability for Hairy Woodpecker to Year 1997 by Alternative

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability*	341	303	320	311	318	325
Change in Capability	0	- 38	-21	-30	-23	-16
Percent Change	0	-11	- 6	-9	- 7	-5

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

* Numbers do not incorporate Patch-size Effectiveness calculations.

Brown Creeper

The brown creeper prefers large old-growth trees. All action alternatives would remove habitat capable of supporting an estimated 20 (Alternative 7) to 53 (Alternative 2) brown creepers (Table Wildlife-14). Alternative 2 would decrease habitat capability by 11 percent, while Alternatives 3, 5, 6, and 7 would be a range of four to eight percent.

Table Wildlife-14
Changes in Habitat Capability for Brown Creeper to Year 1997

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability	497	444	468	455	468	477
Change in Capability	0	- 53	- 29	-42	- 29	- 20
Percent Change	0	-11	- 6	-8	- 6	-4

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

Vancouver Canada Goose

The Vancouver Canada goose nests in forested areas in proximity to open water and preferred food plants. The action alternatives would harvest habitat capable of supporting an estimate of between five (Alternative 7) and seven (Alternative 2 and 5) geese in the Project Area. The action alternatives would decrease habitat capability five to nine percent in the Project Area (Table Wildlife-15).

Table Wildlife-15
Changes in Habitat Capability for Vancouver Canada Goose to Year 1997

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability	74	67	68	67	68	69
Change in Capability	0	-7	- 6	-7	-6	-5
Percent Change	0	-9	- 8	-9	- 8	-7

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

Bald Eagle

Scheduling development activities away from beach fringe, estuary fringe, lake buffers, and Class I and II streams will effectively reduce impacts to bald eagle nesting habitat. No decrease in nesting habitat capability is predicted for any alternatives (Table Wildlife-16). Management activities within one-half mile of an eagle nest site are restricted by an Interagency Agreement between the Forest Service and the U.S. Fish and Wildlife Service (USDA Forest Service and USDI Fish and Wildlife Service 1990). None of the units in the Upper Carroll Project are within one-half mile of known bald eagle nests.

Table Wildlife-16
Changes in Nesting Habitat Capability for Bald Eagle to Year 1997

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability	40	40	40	40	40	40
Change in Capability	0	0	0	0	0	0
Percent Change	0	0	0	0	0	0

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

Gray Wolf

The gray wolf habitat capability model runs off the Sitka black-tailed deer habitat capability model, since there are not any significant numbers of moose or mountain goats in the Project Area. None of the action alternatives influence the deer numbers enough to show a significant change from the current wolf habitat capability. Table Wildlife-17 shows the change in wolf habitat capability resulting from each alternative. The habitat capability does not include the effects of road density, due to the fact that all the road systems are isolated and not connected to any large population centers. The Cumulative Effects section includes a discussion of effects that might be anticipated if project and Ketchikan road systems are connected.

Table Wildlife-17
Changes in Habitat Capability for Gray Wolf to Year 1997

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Habitat Capability	1.1	1.02	1.06	1.04	1.06	1.08
Change in Capability	0	.08	.04	.06	.04	.02
Percent Change	0	-7.3	-3.6	-5.5	-3.6	-1.8

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability model.

Mountain Goat

The Upper Carroll project harvests various levels of mountain goat winter habitat with the different alternatives (Tables Wildlife-18 and Wildlife-19). Of the action alternatives, Alternative 3 harvests the most goat winter habitat (274 acres) while Alternative 7 harvests the least (30 acres).

The goats are concentrated around Mount Reid. The valley west of Mount Reid (which contains units 16, 65, 66, and 67) contains possibly the highest value habitat for goats on Mount Reid due to the fact that it is located so close to the highest concentration of goats. Other patches of winter habitat, including winter habitat east of Mount Reid in Misty Fiords National Monument, are farther away from Mount Reid and are of lesser value to goats on Mount Reid. Alternatives 6 and 7 do not include units 16, 65, 66, and 67 and therefore avoid impacts to the winter habitat closest to Mount Reid. Alternatives 2 and 5 harvest units 16, 66 and 67 but not unit 65. Alternative 3 harvests all four of these units closest to Mount Reid.

Table Wildlife-18
Total Harvest* in Goat Winter Habitat near Mount Reid by Alternative

Category	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Acres Harvested	0	229	274	229	71	30
Percent Harvested	0	2	3	2	<1	<1
Acres Remaining	11,127	10,898	10,853	10,898	11,056	11,096

SOURCE: Burns 1996. Data derived from GIS data base.

* Includes harvesting for units and estimated 75-foot road right-of-way.

Table Wildlife-19
Total Harvest* in Goat Winter Habitat in the Upper Carroll Project Area by Alternative

Category	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Acres Harvested	0	229	274	229	71	30
Percent Harvested	0	8	10	7	2	1
Acres Remaining	2,044	1,814	1,770	1,815	1,972	2,013

SOURCE: Burns 1996. Data derived from GIS data base.

* Includes harvesting for units and estimated 75-foot road right-of-way.

Another concern for impacts to mountain goats is hunting pressure from increased access by new road construction. Hunted populations are sensitive to over harvest and human disturbance. Currently, the population on Mount Reid receives limited harvest pressure.

Open road density will increase as a result of the Upper Carroll Project. Only the mainline road along Carroll Creek will remain open following project completion. Road numbers 846(and 8400700 will be closed just off the mainline road by removing bridges and culverts. This should reduce motorized access into important goat winter habitat associated with these two Carroll Creek tributaries. Hunters and hikers may still access the high elevation goat habitat by foot. Based on this information and the fact that the road system will not be connected to the Ketchikan road system, human use of the area is not expected to increase substantially.

Comparison of Alternatives: Summary

Table Wildlife-20 summarizes the habitat capability for each MIS in 1954, 1995, and 1997. It also includes the percent change from 1954 to 1997.

Table Wildlife-20
Summary of Habitat Capability in the Year 1997 and Percent Change from 1954

		Alt. 1**		Alt. 2		Alt. 3		Alt. 5		Alt. 6		Alt. 7	
Species	1954	1997	% Chg	1997	% Chg	1997	% Chg	1997	% Chg	1997	% Chg	1997	% Chg
Sitka black-tailed deer*	629	389	-38	357	-43	371	-41	364	-42	367	-42	376	-40
black bear	75	70	- 7	66	-12	67	-11	67	-11	67	-11	68	-9
marten*	58	45	-22	40	-31	42	-28	41	-29	42	-28	43	-26
otter	26	17	-35	16	-38	16	-38	16	-38	16	-38	16	-38
red squirrel	24,637	22,714	- 8	21,226	-14	21,890	-11	21,554	-13	21,858	-11	22,178	-10
hairy woodpecker*	501	341	-32	303	-40	320	-36	311	-38	318	-37	325	-35
brown creeper	993	497	-50	444	-55	468	-53	455	-54	468	-53	477	-52
Vancouver Canada goose	86	74	-14	67	-22	68	-21	67	-22	68	-21	69	-20
bald eagle	54	40	-26	40	-26	40	-26	40	-26	40	-26	40	-26
gray wolf	1.8	1.1	-40	1.02	-43	1.06	-41	1.04	-42	1.06	-41	1.08	-40

SOURCE : Burns 1996. Data derived from GIS data base and interagency habitat capability models.

* Numbers do not incorporate Patch-size Effectiveness calculations (see the Old-Growth/Biodiversity section).
** Alt. 1 represents current condition.

Snag Abundance Analysis

TLMP RSDEIS (1996a) Standards and Guidelines call for maintaining snags and reserve trees to provide habitat for cavity nesting wildlife species. An analysis was completed for all VCUs within the Project Area to determine if prior harvest has reduced the number of snags below Forest Standards and Guidelines.

This analysis was accomplished by using snag densities for the various plant associations that were sampled during stand examinations of units in the unit pool within the Project area. In the evaluations, only snags greater than ten inches DBH were counted. Areas that had been previously harvested were assumed to have no snags. The maximum number of snags per acre assumed to be usable was eight per acre; it was assumed that more than eight snags per acre were in excess of nesting and courtship needs of the hairy woodpecker, which was the MIS chosen to represent cavity dwellers and users of snags for the Upper Carroll Project Area. Average snag densities were greater than eight snags/acre for all plant associations. The analysis indicates that there is an adequate number of snags existing in all VCUs (all VCUs have at least twice the number of snags that standards and guidelines call for). However, some VCUs were identified as needing further analysis to confirm adequate distribution of snags since past timber harvest was concentrated, such as VCUs 737 (Bluff Lake area) and 744 (Carroll Creek drainage), or because proposed units were the only source of snags in the immediate vicinity (proposed units harvested a stringer of timber surrounded by non-commercial timber).

Based on map and photo review, the following units will have snag patches within the unit, to maintain a good distribution of available snags:

Unit #	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
13		x				
20		x	x	x	x	x
53		x		x		
76		x		x	x	
83		x		x	x	
95		x				

Cumulative Effects: Reasonably Foreseeable

This portion of the analysis (reasonably foreseeable) will focus on effects to the year 2004, which is halfway through the first rotation and the end of the Long-term Contract with KPC. TLMP RSDEIS (1996a) considers cumulative effects for 150 years and is incorporated here by reference.

Habitat capability was not calculated for State and private lands. This will represent a maximum potential impact, because even if these lands are harvested, they would be providing at least some minimal habitat capability.

Alternative 2 is used to display the reasonably foreseeable future actions, because this is the maximum harvest alternative, and volume not harvested in other action alternatives could be harvested as part of another project by the year 2004.

Table Wildlife-21 shows the direct effects on habitat capability for MIS of the reasonably foreseeable actions from 1954 through 2004, using Alternative 2 as being equal to the total effects of the reasonably foreseeable actions of all the other alternatives.

Table Wildlife-21
Reasonably Foreseeable Direct Changes in Habitat Capability for MIS, 1954-2004.

Species	Habitat Capability 1954	Habitat Capability 1995	Habitat 1/ Capability 2004	Percent 1/ Reduction From 1954
Sitka black-tailed deer 2/	629	389	378	43
black bear 3/	75	70	69	12
marten 2/ 3/	58	45	41	31
river otter	26	16	16	38
red squirrel 2/	24,637	22,714	21,226	14
hairy woodpecker 2/	501	341	303	40
brown creeper 2/	993	497	444	55
Vancouver Canada goose	86	74	67	22
bald eagle	54	40	40	26
gray wolf	1.8	1.1	1.02	43

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability models

1/ Based on Alternative 2, because Alternative 2 is the maximum harvest amount.
2/ Numbers do not incorporate Patch-size Effectiveness calculations (see Old-Growth/Biodiversity section).
3/ Does not consider effects of road densities.

Total Cumulative Direct and Indirect Effects of Habitat Capability for MIS of Proposed Alternatives in 2040

The total cumulative direct and indirect effects are displayed in Table Wildlife-22; this takes into account the effects of canopy closure on units harvested by all alternatives, all other stands that are currently in the clearcut stage and converting them to the second-growth stage, and taking into consideration the effects that road densities would have on habitat capability by year 2040.

Road Density Effects Analysis

The cumulative analysis also displays the effect a road connection between the Project Area and the Ketchikan road system would have on wildlife species, such as gray wolf, black bear, and marten. For this part of the analysis, it is assumed that the Project Area is connected to the Ketchikan road system.

The Project Area includes 70.7 square miles of land. Using Alternative 2 as the maximum amount of road existing in the Project Area, there is a potential for 82 miles of roads (for a density of 1.16 miles of road per square mile of land). Some roads will be closed by pulling bridges and culverts or organic encroachment. This results in a potential for 32.1 miles of open roads (for an open road density of 0.45 miles of road per square mile of land).

Gray Wolf

Concern has been expressed that high road densities and liberal hunting regulations can result in over-harvest of the wolf population. Many studies have shown that wolf abundance may be correlated with road density. In one study, wolves generally were not present where the density of roads used by humans exceeded 0.93 miles per square mile (Mech et al. 1988). However, other work has suggested that wolves could exist in areas with higher road densities if these areas were adjacent to roadless areas (Mech et al. 1988), as is the Upper Carroll Project.

It is assumed that all road closures will be effective, especially since the roads are not connected to the Ketchikan road system and are expected to receive relatively light use. Open road density would range from 0.01 miles per square mile for Alternative 1 to 0.45 miles per square mile for Alternative 2, well below the recommended road density of 0.93 miles of open road per square mile.

Black Bear

Although black bears can adapt to changes in their environment induced by humans, increased access by humans often leads to increased human-related mortality (legal harvest, poaching, and defense of life and property). The black bear habitat capability model has factors that attempt to take this increased mortality into consideration.

For habitat that is linked to a transportation system, the habitat capability of the areas within two miles is reduced by 20 percent. For the analysis of the effect of road density, it is assumed that all areas of the Project Area are within 2 miles of a road. So the black bear habitat capability would be reduced by 20 percent due to a road connection to the Ketchikan road system. Table Wildlife-22 displays the effect of connecting some of the Project Area road system to the Ketchikan road system.

Marten

There is also concern that marten densities will decrease (due to their susceptibility to overtrapping) as road densities exceed 0.2 miles of road per square mile, and marten densities will be reduced 90 percent as road densities approach 0.6 miles of road per square mile (Suring et al. 1992).

Again, assuming that all of the road closures are effective in stopping road use, the open-road density for the Alternative 2 would be 0.45 miles of road per square mile (32.1 divided by 70.7). Comparing the open-road density to the Road Density Graph in the Marten Habitat Capability Model (Suring et al. 1992), the suitability index for marten based on road density is 0.44, so 0.44 was multiplied by the marten model outputs to make adjustments for road densities (see Table Wildlife-22). Miles of open road for the remaining alternatives are: Alternative 3 equals 7.7; Alternative 5 equals 17.5; Alternative 6 equals 9.7; and Alternative 7 equals 3.8, respectively. Alternative 3, 6, and 7 would not result in a reduction of habitat capability due to road density. Road Density in Alternative 5 would reduce habitat capability by a factor of 0.89. The open road density for Alternatives 2 and 5 impacts the marten habitat capability, indicating that road management objects should take wildlife considerations into account if the Project Area is ever connected to the Ketchikan Road system.

Table Wildlife-22

Total Cumulative Direct and Indirect Effects of Habitat Capability for MIS for the Proposed Alternatives of This EIS by 2040 (assuming no further timber harvest)

Species	Habitat Capability 1954	Habitat Capability 1995	Alt. 1	Alt. 2	Habitat Capability 2040 Alt. 3	Alt. 5	Alt. 6	Alt. 7
Sitka black-tailed deer 1/	629	389	389	369	377	373	373	377
black bear 2/	75	70	70	54	54	54	54	55
marten 1/ 2/	58	45	45	18	42	37	42	43
river otter	26	17	17	16	16	16	16	16
red squirrel	24,637	22,714	22,714	21,226	21,890	21,554	21,858	22,178
hairy woodpecker 1/	501	341	341	303	320	311	318	325
brown creeper	993	497	497	444	468	455	468	477
Vancouver Canada goose	86	74	74	67	68	67	68	69
bald eagle	54	40	40	40	40	40	40	40
gray wolf	1.8	1.1	1.1	1.02	1.06	1.04	1.06	1.08

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability models.

1/ Numbers do not incorporate patch-size effectiveness calculations (See Old-Growth/Biodiversity section).
2/ Does consider effects of road densities.

Table Wildlife-23 displays the impacts of harvesting the scheduled acres of the suitable-available forest lands in the 150-year planning period and assumes all harvested stands are in the closed canopy, second-growth condition.

Table Wildlife-23
Total Cumulative Changes Caused by This and Future Timber Sales, in Habitat Capability for MIS to the Year 2140

Species	Habitat Capability 1954	Habitat Capability 1995	Habitat Capability 2004 1/	Percent Reduction From 1954	Habitat Capability 2140 2/	Percent Reduction From 1954
Sitka black-tailed deer 2/	629	389	378	40	350	44
black bear	75	70	69	8	62	17
marten 3/	58	45	41	29	38	34
river otter	26	17	16	38	19	27
red squirrel	24,637	22,714	21,226	14	22,046	11
hairy woodpecker 3/	501	341	303	40	272	46
brown creeper	993	497	444	55	382	62
Vancouver Canada goose	86	74	67	22	44	49
bald eagle	54	40	40	26	39	28
gray wolf	1.8	1.1	1.02	43	1.02	43

SOURCE: Burns 1996. Data derived from GIS data base and interagency habitat capability models.

1/ Based on Alternative 2, because Alternative 2 is the maximum harvest amount.
2/ Assumes harvest of all suitable-available forest lands identified by the TLMP RSDEIS, Preferred Alternative (1996a) within the Project Area.
3/ Numbers do not incorporate Patch-size Effectiveness calculations.

Swan-Tyee Power Transmission Line

According to the Draft Environmental Impact Statement for the Swan Lake/Lake Tyee Intertie, neither of the alternatives and options are expected to have a significant effect on wildlife or wildlife habitat. Of the 14 MIS considered, habitat capability models indicate that habitat capability losses would be similar for Alternatives 2 and 3, and would be greatest for brown bear (-2.2 percent under Alternatives 2 and 3), Sitka black-tailed deer (-1.4 percent under Alternative 3 and -0.9 percent under Alternative 2), wolf (-1.1 percent under Alternative 2 and -1.0 percent under Alternative 3), and hairy woodpecker (-1.1 percent under Alternative 3 and -0.9 percent under Alternative 2).

The intertie project would add additional impacts by creating a minor risk of collisions with overhead wires by waterfowl. Bird flight deviators will be installed to minimize the risks of collision.

The construction of a road from Carroll Inlet to Shrimp Bay would increase vulnerability of wildlife in the Upper Carroll project through increased hunter access. Road densities would be below recommended levels for wolves, bear, and marten. Road densities would increase from an average of 0.2 miles per square mile to 0.31 miles per square mile for all alternatives and options that include the road. The Upper Carroll Project is not expected to add to this mileage since only the mainline road will remain open after completion of the project. This would be the same road evaluated for the Intertie Project. Neither of the projects include a road connection to Ketchikan. Road use is expected to be minimal.

The Draft EIS for the Swan Lake/Lake Tyee Intertie contains the complete analysis for impacts of the project on wildlife species.

Old Growth and Biodiversity

Key Terms

Biodiversity—the variety of life and its processes.
Canopy—the middle and uppermost layers of foliage in the forest.
Corridor—a patch or strip of habitat linking or providing connectivity between larger patches.
Edge—boundary between two distinct ecosystems, such as between forest and muskeg.
Forage—to search for food.
Fragmentation—reducing the size and connectivity of habitat patches; the degree and impacts of fragmentation depend on scale (in space and time) and the life requirements of the affected species.
Patch—an assemblage of similar vegetation, such as old-growth forest.
Planning Area—for the purpose of analyzing viable populations, the planning area is the ecological province, i.e., Revilla Island/Cleveland Peninsula.
Snag—standing dead tree.
Viable Population—a population with the estimated numbers and distribution of reproductive individuals to maintain the population over time.

Affected Environment

Old-growth Forest

Most of the commercial forest land (CFL) in the Tongass National Forest that has not been previously harvested has been undisturbed for centuries and is considered old growth. The definition of old-growth forest varies by habitat and includes such factors as age and size of trees, spacing, snags, canopy layers and structure, and the amount of down (on-the-ground) material (USDA Forest Service 1991a).

Old-growth stands have an uneven appearance because they contain trees of many ages, sizes, and condition, and contain numerous dead tops and snags. Based on past forest inventories, old-growth stands are assumed to have reached an equilibrium where timber growth equals mortality (USDA Forest Service 1991a). Tree establishment largely depends on large woody debris (logs and stumps) (Harmon 1986, Harmon and Franklin 1989) and gap formation (Alaback 1988). Woody debris provides microsites for trees to grow on. Gaps created by windthrow or other disturbances allow light to penetrate to the forest floor. This process of tree death and replacement is continual; in any one year, a significant portion of the trees in individual stands are likely to blow down (Harris 1989). Thus, the forest is a mosaic of older and younger trees, dynamically changing yet remaining remarkably stable as a forested ecosystem (Bormann and Likens 1979, Alaback 1988, Schoen et al. 1988, Franklin 1990).

Old-growth forest is an important source of highly valuable forest products. Sitka spruce and western hemlock are eminently suitable for the production of dissolving pulp, which is used in the manufacture of rayon, acetates, and other synthetic fibers. The better grade trees of these species, along with the cedars, provide some of the finest quality commercial timber for lumber.

Old-growth forest is also important as wildlife habitat for old-growth associated species such as Sitka black-tailed deer, martens, black bear, Vancouver Canada geese, and cavity or snag-dependent species such as flying squirrels, woodpeckers, and owls. Many species have evolved to use the structural attributes of old-growth forests. The combination of a dense canopy with scattered small openings (typically 20 to 40 feet across) allows forage growth under openings, while the large limbs within the canopy intercept enough snowfall to provide winter food and thermal cover for deer and other species. The large, dense stems also provide some measure of thermal insulation in the winter, as well as during cold rains in the spring and summer. Large dead or defective trees become nesting sites for martens, owls, eagles, wrens, and chickadees, as well as feeding sites for woodpeckers, sapsuckers, brown creepers, and others.

The value of old-growth forest for wildlife habitat is also thought to transcend individual stands. Large, contiguous, unfragmented blocks of old-growth forest are important to forest interior species, such as the northern goshawk and marbled murrelet. The large old-growth blocks provide expansive hunting territories and protection from predators, and promote genetic mixing among populations that would be less likely to breed if they were spatially separated by forest fragmentation. Deer use these large old-growth blocks for migration routes between winter and summer ranges.

Old-growth forests are an important, but decreasing, component of the temperate rain forest ecosystem. They differ in ecological function in many ways from younger, even-aged forests. Old-growth stands typically exhibit a wider variety of reproductive niches for species whose existence is thought to be old-growth dependent, including certain animals, understory plants, and microorganisms which appear to be most successful when permitted to develop under at least a partially intact mature forest canopy.

Old-growth forests also have become important to many people for aesthetic and cultural purposes. Large trees, characteristic of some old-growth stands, have become symbols of a pristine landscape.

Upper Carroll Old-growth Blocks

Within and immediately adjacent to the Project Area are large, unroaded blocks of old-growth forest (Table Old Growth-1 and Figure Old Growth-1) as identified in the roadless inventory in the TLMP Draft Revision (1991a and 1996a). The Revilla block (No. 524) is south of the Upper Carroll Project Area. This block contains approximately 131,856 acres. Just north of the Revilla block is the 158,831 acre North Revilla block (No. 526) and includes important wildlife areas such as the Naha LUD II area, Orchard Lake and Creek, Upper Carroll, and areas in Traitors Cove. Both the Revilla and the North Revilla blocks are adjacent to the 2.1 million acre Misty Fiords National Monument. The Neets block (No. 527) is 6,315 acres. This roadless area is surrounded by clearcuts and is located on a peninsula between Neets Bay and Gedney Pass.

Figure Old Growth-1 shows these and other large blocks of old-growth forest, while the Existing Condition Map in the separate map packet shows all remaining unharvested, old-growth, commercial forest within the Project Area.

Table Old Growth-1
Roadless Areas and Acreage Within and Adjacent to the Upper Carroll Project Area

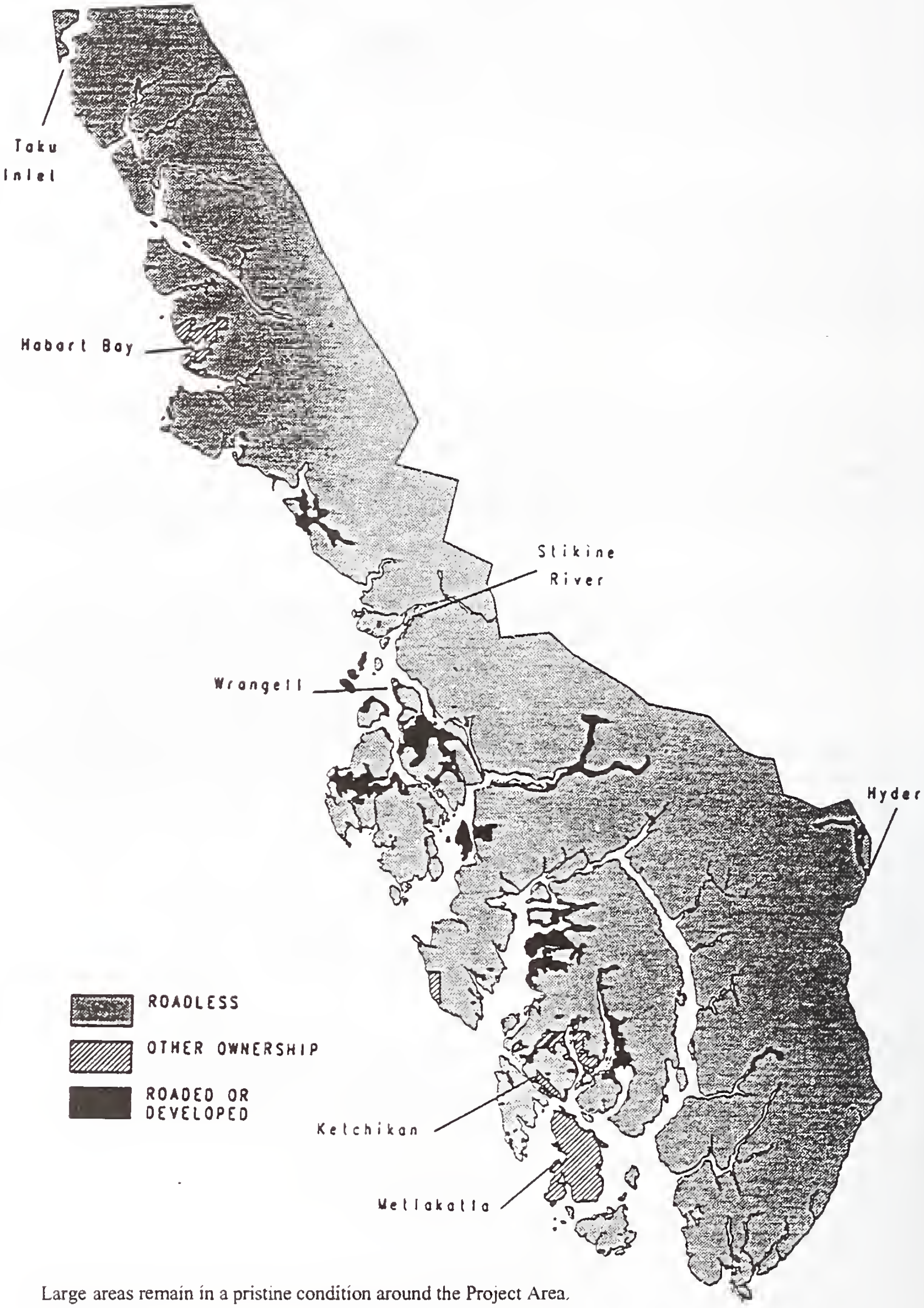
*Roadless Area No.	Roadless Area Name	Roadless Area Acreage
524	Revilla	131,856
526	North Revilla	158,831
527	Neets	6,315
	Misty Fiords NM	234,930
Total		**531,932**

SOURCE: Burns 1996

* These roadless areas are Forest Plan, not Rare II Roadless Areas (See Appendix E, TLMP Revision, 1991a).
** Misty Fiords National Monument acreage represents only the acres on Revillagigedo (Revilla) Island.

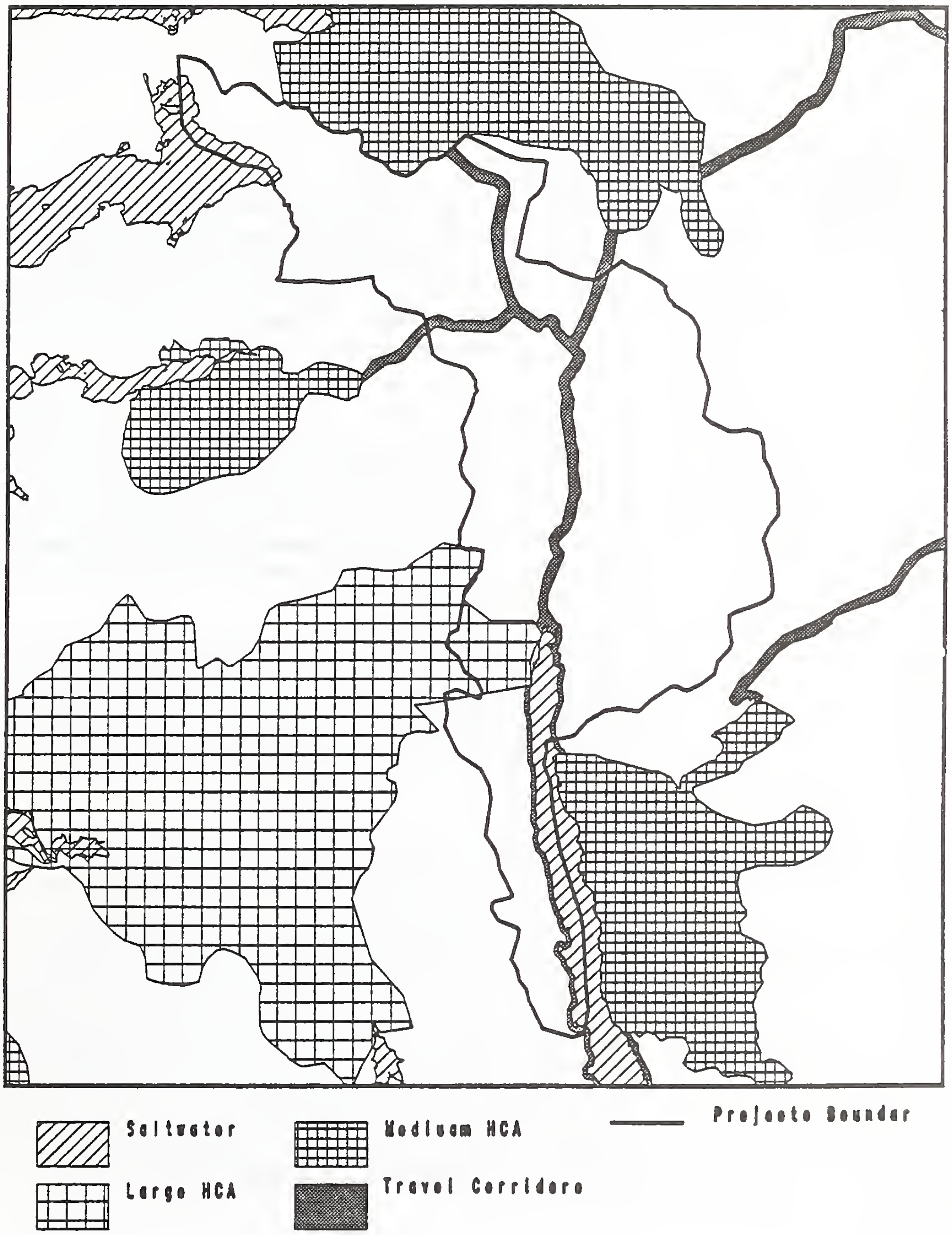
It is recognized that maintaining appropriate habitat corridors or connections between blocks of old-growth forest habitat is important to minimize isolation and gradual decline of wildlife species associated with the old-growth blocks (Harris 1984, 1985; Hunter 1990). Some of the corridors between these blocks have been affected by previous timber harvest activities. While Figure Old Growth-1 displays the areas that are not roaded or developed, Figure Old Growth-2 displays large blocks dominated by old-growth forest and areas that are important for maintaining connectivity between the large blocks.

Figure Old Growth-1
Roadless Areas from Hyder/Misty Fiords National Monument North to Juneau/Skagway



Large areas remain in a pristine condition around the Project Area.

Figure Old Growth-2
Important Old-growth Blocks and Corridors



Large blocks of old-growth forest and other areas that are important for maintaining connectivity between the large blocks.

Other areas (including stands deemed inoperable for timber harvest because of unstable soils, steep slopes, economic isolation, or other factors) could also be interspersed and provide additional opportunities to connect old-growth blocks. While there has been historic timber harvest within the beach, estuary, and streamcourse buffers, these old harvest sites will mature in time and could provide travel corridors for some wildlife species for genetic interchange.

For additional discussion of old growth and connectivity, see Fragmentation and Connectivity later in this section.

Biological Diversity and Viable Populations

Biodiversity

National Forest Management Act (NFMA) regulations define diversity as the distribution and abundance of different plant and animal communities and species. Biological diversity, or biodiversity, refers not only to the variety of organisms in an area; it also includes their genetic composition, the complex pathways that link organisms to one another and to the environment, and the processes that sustain the whole system. Biodiversity plays a key role in how well an ecosystem functions. It can be evaluated at different scales, ranging from genetic diversity to landscape diversity.

Genetic diversity is the smallest scale. It refers to the variation in the genes of individual plants, animals, and microorganisms. There is concern when individuals of a species do not reproduce very well (such as Pacific yew) or do not show much variation among individuals. Species diversity refers to the variety of living organisms, ranging from beetles to bears, from mosses to massive trees. This scale not only includes the number of different species in an area, but also their abundance and distribution. Loss of genetic diversity and/or severe reductions in the size of populations can subject plant and animal species to increased risk of local extinction (extirpation).

This risk of genetic and species loss is higher if the structure, composition, or function of vital habitats are compromised. An example of such a compromise might be fragmentation of large blocks of suitable habitat into smaller isolated blocks that separate small populations of wildlife species from each other. In managing forest ecosystems, therefore, biodiversity management is often evaluated at larger scales. It is thought that conservation of functioning ecosystems will serve to conserve the species associated with them.

One of these larger scales of diversity "within-ecosystem" focuses on plant associations and habitat types, and the diversity of plants and animals within those communities. This diversity scale usually measures the number of species present (richness) or the structural complexity of a given habitat type . For example, the number of breeding birds in Southeast Alaska has been shown to decline from 13 species in old-growth spruce-hemlock forests to just three species immediately following logging (seedling/sapling stage) as vegetation structure and species composition become greatly simplified (Sidle 1985). As clearcuts (seedling/sapling stage) proceed to mid-successional stages (sapling/shrub and pole), species richness temporarily increases to 10 to 14 species, but declines again to seven species in older seral stages (young sawtimber) due to the loss of understory vegetation associated with canopy closure. Retention of snags, live trees, and down woody debris can be used to enhance within-ecosystem diversity by maintaining a portion of old-growth structure within regenerating stands (Sidle 1985, DellaSala 1993).

The next scale is "between-ecosystem" diversity, which describes the variation from one community to another in a particular area along environmental gradients. Southeast Alaska has a high between-ecosystem diversity, because natural forested patches are relatively small (compared to Oregon and Washington, for example) and are often interspersed in a matrix of muskegs. Large-scale logging can affect this diversity, because it increases the fragmentation of old-growth patches and is followed by a subsequent uniform age class of second growth that is quite different both from the adjacent old growth and from the muskeg matrix.

The largest scale considered is the diversity of ecosystems across a landscape, such as a province or biogeographic region. At this scale, differences in geology, for example, the karst region on northern Prince of Wales, and climate come into play. Large areas of several million acres are evaluated and subdivided into ecological provinces and subprovinces (as in the TLMP RSDEIS, 1996a). An area is expected to support high levels of landscape diversity if viable populations of wildlife and habitat types are well distributed across the region. Evaluation of this scale of diversity is important for a number of reasons. Silviculturally, for example, a plant association on limestone-derived soils may respond differently following logging than the same plant association on glacial soils. The frequency of certain forest structural patterns (size and distribution of trees) may also differ on different soils, with profound implications for wildlife habitat.

Diversity is evaluated at all levels, because ignoring scale can lead to adverse effects on ecosystem function. For example, for years it was thought that maximizing forest fragmentation (the "staggered setting" approach) would benefit wildlife because it maximized forest edges (boundaries between ecosystems). More recent research has found, however, that maximizing edge can ruin forest interior conditions critical for certain species (Forman and Godron 1986, Hunter 1990).

The amount of contiguous habitat, and the extent to which similar habitats connect by corridors, are considered key concepts in managing for biological diversity (Harris 1984, 1985; Hunter 1990). Because of the importance of unfragmented old-growth forest patches and the role of these areas in maintaining viable wildlife populations, old-growth habitat and an analysis of patch-size effectiveness will be used in this EIS as tools to evaluate impacts on biodiversity.

For detailed discussion of old-growth blocks and connecting corridors in the Upper Carroll Project Area, see Upper Carroll Old-growth Blocks (page 3-130), earlier in this section, and Fragmentation and Connectivity (page 3-139) later in this section.

A more detailed discussion of Tongass National Forest direction for managing biological diversity can be found in the TLMP RSDEIS (1996a).

Viable Populations

Regulations developed to implement the National Forest Management Act of 1976 on National Forests state in part: "*Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area*" (36 CFR 219.19). Wildlife habitat planning and management for viable populations is carried out in the context of overall multiple-use objectives.

The task of maintaining habitats to support biodiversity has encompassed several methodologies, and alternatives continue to evolve. The TLMP (1979a) established old-growth habitat areas (retention and extended rotation) that were to be retained partially to maintain biodiversity. The first TLMP Draft Revision (1990) recommended protection of 24 percent of the CFL of each Wildlife Analysis Area, mostly in blocks of 1,000 to 10,000 acres. The TLMP Supplement to the Draft EIS (1991a) refocused its biodiversity and population viability management strategies at the ecological province level, and took a broader regional view. The Interagency Viable Population Committee (VPOP) of biologists made other recommendations, discussed below.

The TLMP (1979a) did not locate retention habitats or contain specific habitat management standards and guidelines for maintaining habitat to support well-distributed viable populations of goshawks, wolves, or other individual wildlife species.

The TLMP (1979a) identified the need to set aside areas of operable commercial forest land for the protection of wildlife and fish that are dependent upon old-growth habitat for their survival. These areas are called Old-growth Prescription (retention) areas. In addition to Old-growth Prescription areas, additional old-growth areas would be designated to benefit wildlife through 2054 (the end of the first 100-year harvest rotation), in lands classified as follows (1989-94 Long-term Sale EIS):

- Inoperable commercial land.
- Lands in extended rotation.
- Lands in Aquatic Habitat Management old-growth prescriptions.
- Lands reserved for recreation purposes.

The TLMP Draft Revision (1991a) provided for regional management and maintenance of population viability at the planning area level. "Planning Area," for defining viable populations, is the ecological province level (TLMP 1991a). Under TLMP (1991a), individual project areas are not expected to independently maintain viable populations, but only to contribute to and not cause a decline of overall viable populations for the province. However, their contribution to well-distributed populations through the maintenance of connectivity can be critical. Standards and guidelines outline prescriptions for maintaining biodiversity at the Project Area level (TLMP 1991a).

The Upper Carroll Project Area lies within the Revillagigedo (Revilla) Island/Cleveland Peninsula Ecological Province (No. 15), as defined by TLMP RSDEIS (1996a). This province is comprised of 1,169,559 acres, of which 349,879 acres are designated for preservation in a natural setting under the terms of the Preferred Alternative for the TLMP RSDEIS (1996a). These 349,879 acres are composed largely of LUD I and II areas, as well as buffers for beach fringe, estuaries, streams, riparian management areas, and eagle nests.

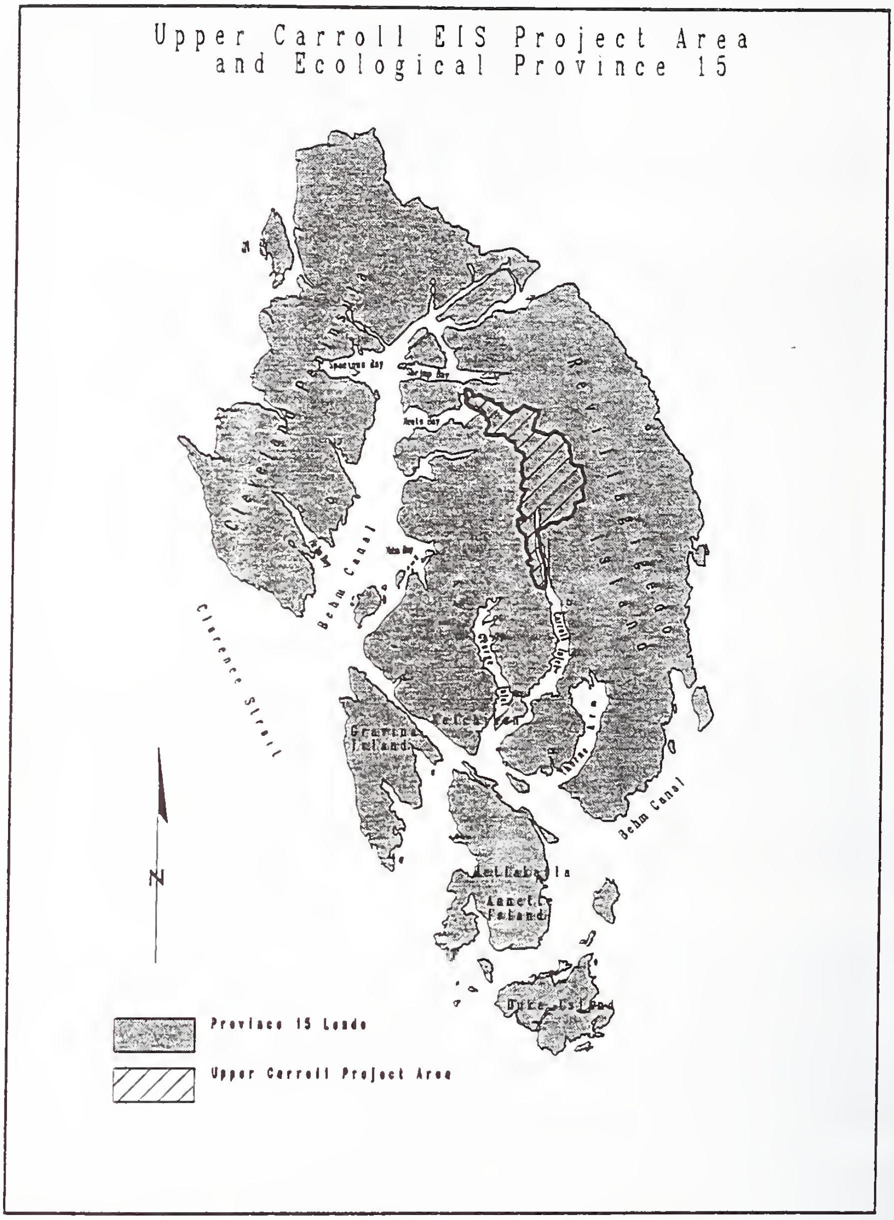
The Revilla Island portion of the ecological province is undeveloped on the east side, and is part of the Misty Fiords National Monument. The Cleveland Peninsula portion of the North Revilla/Cleveland Peninsula Ecological Province is part of the mainland in the Southeast Alaska panhandle. The entire mainland from Hyder/Misty Fiords National Monument north to Juneau/ Skagway area is in a natural (unaltered by human activities) state, except for some small isolated developments (see Figure Old Growth-1).

Figure Old Growth-3 illustrates the setting of the Project Area within the North Revilla/Cleveland Peninsula Ecological Province (No. 15).

Under the TLMP RSDEIS (1996a), a variety of different LUDs preserve particular old-growth areas from timber harvest (i.e. beach fringe and estuary, stream protection, LUD II, special interest areas, old-growth reserves). This designation of no programmed harvest LUDs is intended to allow for seasonal wildlife migration from lowland to higher elevation ranges, to provide adequate acreage for forest interior and old-growth dependent species, and to facilitate genetic exchange between wildlife populations.

The TLMP RSDEIS (1996a) Preferred Alternative maintains wildlife populations through a complex of large, medium, and small old-growth habitat reserves laid out across the Tongass National Forest totaling one million acres, outside congressionally designated areas. This strategy implements the concepts recommended by the VPOP Committee.

Figure Old Growth-3
North Revilla/Cleveland Peninsula Ecological Province, No. 15



This province is comprised of 1,169,559 acres, of which 349, 879 acres are designated for preservation in a natural setting in the Preferred Alternative of the TLMP RSDEIS (1996a).

VPOP Committee

In an effort to further refine the methodology by which viable populations are maintained, an interagency committee of wildlife biologists appointed by the Forest Service was assembled (Viable Population [VPOP] Committee) to assess whether some species associated with old-growth forests required special standards and guidelines to ensure that their populations remain viable and well distributed across their current ranges on the Tongass National Forest. The VPOP Committee's draft recommendations were reviewed by the management-level Steering Committee on Viable Populations (Capp et al., October 1991). The VPOP Committee focused on viability risk assessments that could be applied to the evaluation of planning alternatives Forest-wide. The VPOP Committee recommended habitat conservation areas (HCAs) of three sizes: large, medium, and small (Suring et al. 1993). The three different HCAs could be applied to individual planning areas or to multiple planning areas provided sufficient connecting corridors are present to permit dispersal of wildlife across HCAs. The committee formulated criteria for establishing HCAs.

For a large HCA, a tract should include at least 20,000 acres of old-growth with over 8 MBF per acre, including at least 10,000 acres with over 20 MBF per acre within a tract of at least 40,000 acres. Large HCAs should be no more than 20 miles apart, edge-to-edge, to ensure effective dispersal between them. HCAs with these characteristics are believed to be necessary to ensure that viable populations of wide-ranging species such as marten are well distributed within an analysis area.

A medium HCA would encompass at least 5,000 acres of old-growth forest with over 8 MBF per acre, including at least 2,500 acres of old-growth forest with over 20 MBF per acre within a tract of at least 10,000 acres. Medium HCAs are capable of supporting at least five female martens during winters of poor prey (Suring et al. 1992).

Small HCAs would include at least 800 acres of old-growth forest having over 8 MBF per acre within a tract of at least 1,600 acres. Small HCAs are capable of supporting at least one female marten during winters of poor prey. Small HCAs are maintained to provide temporary functional habitat for wildlife dispersing between large and medium HCAs. The small HCAs also contribute to the landscape matrix between large and medium HCAs.

The TLMP RSDEIS (1996a) Preferred Alternative would maintain wildlife populations through a complex of large, medium, and small old-growth habitat reserves laid out across the Tongass National Forest totaling one million acres, outside congressionally designated areas. This strategy implements the concepts recommended by the VPOP Committee. Within the Upper Carroll Project Area, one block of old-growth forest that was recommended to be retained as an old-growth reserve—the Naha LUD II HCA (approximately 40,100 acres)—includes a small portion of the Project Area on the west side of Carroll Inlet near the head of the inlet. The Orchard Lake/Creek area (approximately 15,100 acres) lies immediately north of the Project Area, while the Swan Lake block (13,500 acres) is immediately to the south on the east side of Carroll Inlet. The Traitors Creek block (approximately 5,500 acres) is west of the Project Area and surrounds the Traitors Cove saltchuck.

Fragmentation and Connectivity

The extinction of species is a serious and irreversible threat. Habitat loss and fragmentation are prime causes of extinction today. Fragmentation occurs whenever a large continuous habitat is transformed into smaller patches that are isolated from each other, such as occurs from catastrophic windstorms or from extensive clearcutting. The changed landscape functions as a barrier to dispersal for species associated with the original habitat. These smaller and more isolated habitats also support smaller populations, which are more vulnerable to local extinction.

Research shows that forest fragmentation results in an increased ratio of forest "edge" to forest "interior" habitat, and can have a strong negative effect on forest interior species. One such effect is that as more edge habitat becomes available as a result of fragmentation, the edge-dwelling species invade the interior environment and become a major threat to the survival of the forest interior species. Rosenberg and Raphael (1986) recommended a minimum stand size of 50 acres when delineating old-growth habitat, and suggested that when a stand is greater than 50 percent isolated, the minimum stand size should be 124 acres. By maintaining large contiguous blocks of habitat, the forest interior species would realize less competition and predation from open forest and edge species.

Patch Sizes

The analysis of forest fragmentation in the Upper Carroll Project Area was based on the total number of old-growth forest patches within specific size classes. Patch-size classes were selected to represent management indicator species (MIS) requirements based on the species patch-size effectiveness curves (Tables Old-Growth-2 and Old-Growth-3). Old-growth forest patches were defined as the amount of contiguous old-growth of Volume Class 4 and above.

Table Old-Growth-2
Patch-size Class Relationships

Patch Size (Acres)	Species Relationship
0-25	Incorporates optimal patch size for red squirrel
26-100	Incorporates optimal patch size for brown creeper
101-500	Incorporates optimal patch size for marten
501-1,000	Incorporates optimal patch size for woodpeckers
> 1,000	Incorporates optimal patch size for deer

SOURCE: Workshop to recommend patch size relationship and corridor requirements for the management indicator species (MIS) and threatened and endangered species (TES) (1989).

Table Old-Growth-3
Patch-size Effectiveness Values by Patch Size Class and by Species

	Patch Size Classes (Acres)				
Species	**0-25**	**26-100**	**101-500**	**501-1,000**	**> 1,000+**
Sitka black-tailed deer	0.3	0.35	0.5	0.83	1.0
marten	0.2	0.5	1.0	1.0	1.0
red squirrel	0.4	1.0	1.0	1.0	1.0
hairy woodpecker	0.1	0.42	.7	1.0	1.0
brown creeper	0.8	1.0	1.0	1.0	1.0

SOURCE: Workshop to recommend patch size relationships and corridor requirements for the MIS and TES.

* Represents the median curve value within each patch size class from the species effectiveness curves.

Patch Size and Corridor Requirements of MIS and TES

An interdisciplinary group of biologists from Alaska Department of Fish and Game, Forest Service, and the U.S. Fish & Wildlife Service (1989) categorized management indicator species (MIS) and threatened and endangered species (TES) into one of three groupings based on how the species generally utilize or respond to their environment with regard to needing minimum habitat patch sizes and/or dispersal corridors.

Landscape

Wildlife species in this category generally have large seasonal or year-long home ranges and territories. These species are capable of utilizing a wide variety of vegetative conditions, although preferences for certain vegetation types exist which provide a higher quantity/quality of forage or cover needs. These species will travel or move through a wide variety of habitats to utilize their environment; therefore, these species do not have specific patch size or corridor requirements

Community

Wildlife species in this category generally have smaller home ranges and territories than the landscape species. These species show a high preference or requirement for a particular vegetation community or combination of communities, especially during the season of the year that is considered critical. Preferred or required habitats may need to be within mean dispersal distances of the species, and corridors may be needed. These species generally show a relationship with patch size of the preferred or required habitats. In some situations, as patch sizes are reduced, a species may be displaced by another species which can more effectively use the habitat.

Structural
Wildlife species in this category require a specific or unique habitat element or site, such as a pond or cliff for nesting. Often, the size, location, and abundance of these sites are the result of natural geologic or climatic events rather than the effects of management.

Each of the MIS and TES that occurs within the Upper Carroll Project Area was placed within one of the above groups as follows:

Landscape	Community	Structural
black bear	marten	bald eagle
gray wolf	hairy woodpecker	trumpeter swan
river otter	brown creeper	peregrine falcon
mountain goat	marbled murrelet	
	Vancouver Canada goose	
	Sitka black-tailed deer	
	red squirrel	

For the species within the landscape and structural groups, no specific patch size or corridor requirements are needed. For the species within the community category, the committee identified types of vegetative communities or habitats that are applicable to patch sizes and corridor requirements for each species. These include:

Marten
Marten patch size includes the acres of all conifer stands from older second growth and all CFL old growth; corridor requirements include all conifer stands from older pole timber through old growth.

Hairy Woodpecker
Hairy woodpecker patch size includes all old-growth conifer stands plus older second-growth stands; there are no corridor requirements for this species.

Brown Creeper
Brown creeper patch size includes all Volume Class 5+ old-growth conifer stands; there are no corridor requirements for this species.

Marbled Murrelet
Marbled murrelet patch size includes all old-growth conifer stands; there are no corridor requirements for this species, as it has been observed flying in the subalpine and alpine habitats.

Vancouver Canada Goose
Adequate information was not available to develop patch size relationship for this species. These birds are highly mobile and are found throughout the islands of Southeast Alaska. No vegetative corridor requirements have been identified.

Sitka Black-tailed Deer
Sitka black-tailed deer patch size includes all old-growth stands; no specific corridor requirements were developed.

Red Squirrel
Red squirrel patch size includes the acreages of all cone producing stands of conifer trees; corridor requirements include all pole timber or larger or older stands of trees.

The relationship of patch size to the effectiveness of that habitat to support a particular species was analyzed, and index graphs were developed. Table Old-Growth-3 displays a summary of the effectiveness of various patch size classes for the above Upper Carroll MIS.

Prior to timber harvest (1954), the Project Area contained extensive amounts of unfragmented forest patches that met the criteria of small, medium, and large old-growth blocks (Figure Old Growth-4 map of distribution of forest patches in 1954, later in this section). Approximately 65 percent of the old growth in Volume Class 4 and above throughout the Project Area was in forest patches greater than 1,000 acres. Timber harvest under the Long-term Contract has decreased the acreage in this patch size class from 17,902 acres to 11,736 acres, see Figure Old Growth-4 (1954 condition), and Figure Old Growth-5 (existing condition, Alternative 1), later in this section.

Fragmentation of existing old-growth results in a reduction in the effectiveness of remaining patches as wildlife habitat. Individual species respond to natural and human-induced fragmentation differently. Species like brown creepers and hairy woodpeckers can be supported by smaller patches of forest habitat than species such as deer and marten (proceedings of workshop to recommend patch-size relationships and corridor requirements for the MIS and TES) (Table Old Growth-4).

Patch-size effectiveness percentages for 1954, range from 99.7 percent (brown creepers) to 92.1 percent for deer (Table Old Growth-4). The values for 1995, vary from 99.5 percent effective to 87.2 percent effective. The greatest difference in percent effectiveness between 1954 and 1995 was for deer.

Table Old Growth-4
Adjusted Habitat Capabilities Based on Patch-size Effectiveness

Species	1954 W/o*	1995 W/o*	1954 With**	1954 Patch Effect %	1995 With**	1995 Patch Effect %
Sitka black-tailed deer	628	389	578	92.1	339	87.2
marten	50	45	48	96.7	42	94.3
red squirrel	24,637	22,714	24,391	99.0	22,373	98.5
hairy woodpecker	501	341	472	94.2	306	89.7
brown creeper	993	497	990	99.7	495	99.5

SOURCE: MIS Habitat Capability Models.

* Without patch-effectiveness percent applied.
** With patch-effectiveness percent applied.

Connectivity

The connectivity, or corridors, between habitat patches in a landscape may be at least as significant to maintaining diversity as the size of the patches (Noss 1983). Forman and Godron (1981) defined corridors as being of four types: (1) line corridors, those which are all edge and possess no interior habitat; (2) strip corridors, those which maintain interior habitat; (3) stream corridors, those bordering a water source; and (4) network corridors, those which intersect and form patterns. Corridors can function as more than one type; for example, when a stream corridor is wide enough to incorporate interior habitat, it also functions as a strip corridor. Forman and Godron's work also highlighted the fact that some interior species will not live in or even migrate through extensive lengths of unsuitable habitat, and that strip corridors were preferable to line corridors. Management of corridors as well as habitat patches should strive to mimic natural patterns (Noss and Harris 1986).

The main dispersal corridors throughout Revilla Island are thought to be the Orchard Creek and Carroll Creek drainages and have not been affected by timber harvest. The Traitors Creek drainage is connected to this dispersal corridor through a pass in the northeast portion of the Traitors Creek drainage which has had some scattered timber harvest activity. Carroll Creek drainage is the most important wildlife habitat area in the Project Area.

Effects of the Alternatives

Analysis conducted for the TLMP RSDEIS (1996a) indicates that 66 to 94 percent of the productive old-growth forest would remain distributed throughout the planning cycle (150 years) within the Revilla Island/Cleveland Ecological Province to potentially support viable populations of Management Indicator Species (MIS). Under the 1979 Forest Plan (1979a), approximately 200,000 acres of productive old-growth forest would remain to potentially support viable populations of MIS. All alternatives proposed by this EIS provide areas that would remain connected by existing roadless areas, beach fringe, estuary fringe, stream corridors, and the myriad of oversteepened slopes and other areas unsuitable for timber harvest. Managed stands would change from multi-aged old-growth timber to even-aged stands of timber in early succession/understory colonization stage.

Following clearcut logging of old-growth forest, the stands that subsequently develop are even-aged (Harris and Farr 1974) and tend to contain a higher percentage of Sitka spruce and a lower percentage of the cedars. Clearcutting differs from natural disturbances in that it represents a large-scale change (up to 100 acres, typically) rather than dispersed small (one to 20 acres, typically) partially blowdown patches. It also differs in that nearly all trees are felled, whereas in natural disturbances many trees remain standing or partially standing (Hansen et al. 1991).

There has been a national concern over the limited and dwindling supply of old-growth forest, as exemplified by the spotted owl controversy in Oregon and Washington. Approximately six percent of the old-growth forest in the Revilla Island/Cleveland Peninsula has been harvested. Under the TLMP RSDEIS (1996a) Preferred Alternative, approximately 22 percent of the old-growth forest in the Revilla Island/Cleveland Ecological Province will eventually be converted from old-growth forest to successive crops of younger trees which will be harvested before they mature into old-growth forest (TLMP RSDEIS 1996a). The subsequent crops of younger trees will yield more usable wood fiber per acre. At the same time, this conversion of old-growth forest to younger stands will cause some changes in the value of certain forest products, changes in value of wildlife habitat, reductions in diversity of ecosystem function and composition, and changes in inherent aesthetic qualities. Figure Old Growth-4 displays the amount of old-growth habitat within the Project Area that existed in 1954. The effect of proposed alternatives on existing old-growth (Figure Old Growth-5) is displayed in Figures Old Growth-6 through Old Growth-10.

Fragmentation and Patch-size Effectiveness

To help identify important blocks of old-growth habitat, a map was generated using the Geographic Information System (GIS) that displayed all blocks of old-growth timber volume Class 4 and greater. The patches were then categorized into the various acreage classes. This procedure was completed for the years 1954 (prior to logging) and 1995 (the current condition, Alternative 1), and for Alternatives 2 through 7. These patches are displayed in Figures Old Growth-4 through Old Growth-10. Table Old Growth-5 displays the acreage in each patch-size class, for the year 1954, the existing condition (1995), and Alternatives 2 through 7.

Of the action alternatives, Alternatives 3, 6, and 7 are the best alternatives for maintaining the large blocks of old-growth habitat, while Alternative 2 has the most impact on large blocks.

Table-Old Growth-5
Patch-size Acreage by Alternative

Alt.	>1,000 Acre Patches	500-1,000 Acre Patches	100-500 Acre Patches	26-100 Acre Patches	0-25 Acre Patches
1954	17,902	981	1,448	853	365
1	11,735	2,270	2,243	1,326	451
2	4,563	5,881	3,492	1,660	652
3	7,135	4,381	3,329	1,602	620
5	4,494	6,282	3,607	1,534	655
6	7,940	4,058	2,920	1,575	619
7	7,724	4,601	3,027	1,596	573

SOURCE: Burns 1996, GIS database

Table Old Growth-6
Adjusted Habitat Capabilities Based on Patch Size and the Percent Effective by Alternative

Species	1954	Alt. 1 Existing Condition	Alt. 2 1997	Alt. 3 1997	Alt. 5 1997	Alt. 6 1997	Alt. 7 1997
Sitka black-tailed deer	579	339	263	286	269	290	296
percent effective	92.1	87.2	73.7	77.2	73.9	78.9	78.7
marten	56	42	37	39	38	39	40
percent effective	95.7	94.3	91.7	92.4	92.2	92.5	92.8
red squirrel	24,391	22,373	20,717	21,408	21,037	21,377	21,734
percent effective	99.0	98.5	97.6	97.8	97.6	97.8	98.0
hairy woodpecker	472	306	255	273	263	274	281
percent effective	94.2	89.7	84.0	85.4	84.5	86.3	86.6
brown creeper	990	495	440	465	451	465	474
percent effective	99.7	99.5	99.2	99.3	99.2	99.3	99.3

SOURCE: Burns 1996, GIS database

Effect of Proposed Alternatives on Old-growth Habitat in Upper Carroll

Figure Old Growth-7 represents the pre-harvest (1954) condition, while Figure Old Growth-8 represents the existing condition (Alternative 1), and Figures Old Growth-9 through Old Growth-13 show the effect that the alternatives would have on the existing large blocks of old-growth forest. Past timber harvest activity has reduced the amount of old-growth forest in blocks greater than 1,000 acres and also a corresponding decrease in the total amount of old-growth forest that is in the Project Area. The action alternatives also reduce the amount of old-growth timber remaining in blocks greater than 1,000 acres.

Figure Old Growth-4
Patch-size Effectiveness, 1954

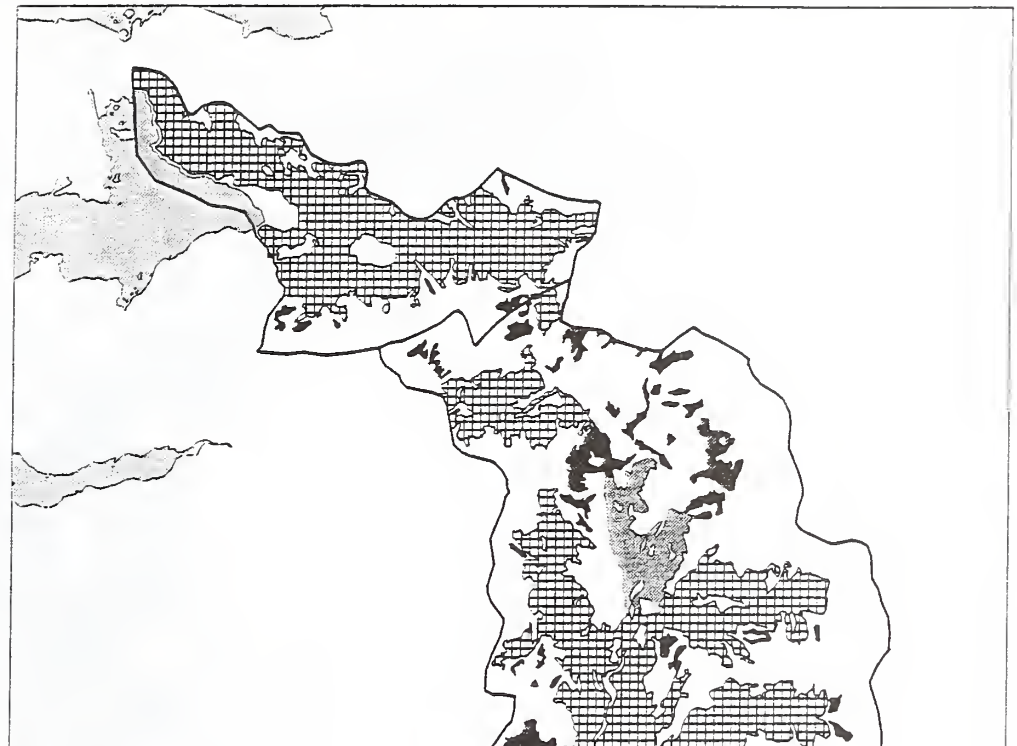


Figure Old Growth-5
Patch-size Effectiveness, Alternative 1

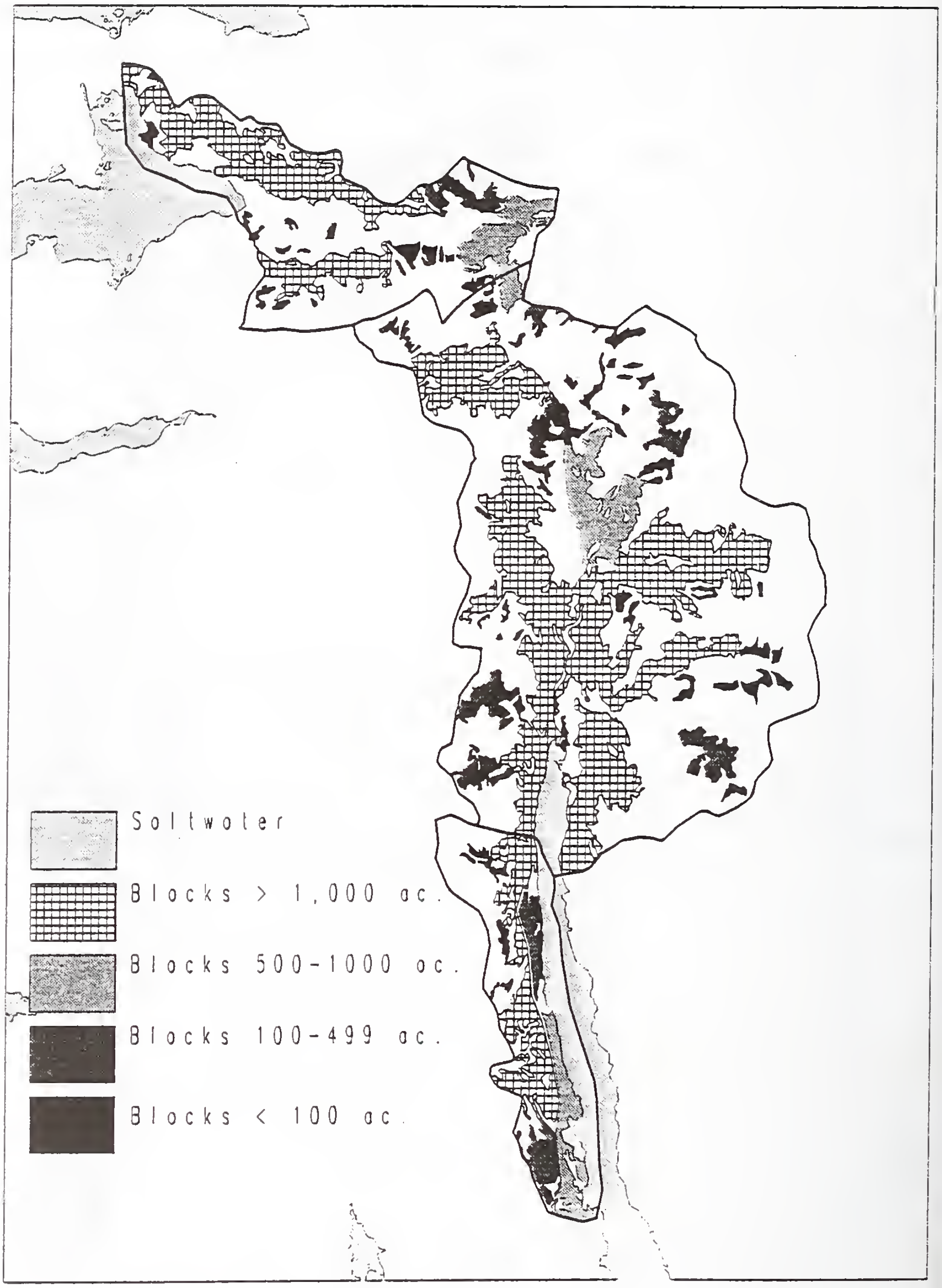


Figure Old Growth-6
Patch-size Effectiveness, Alternative 2

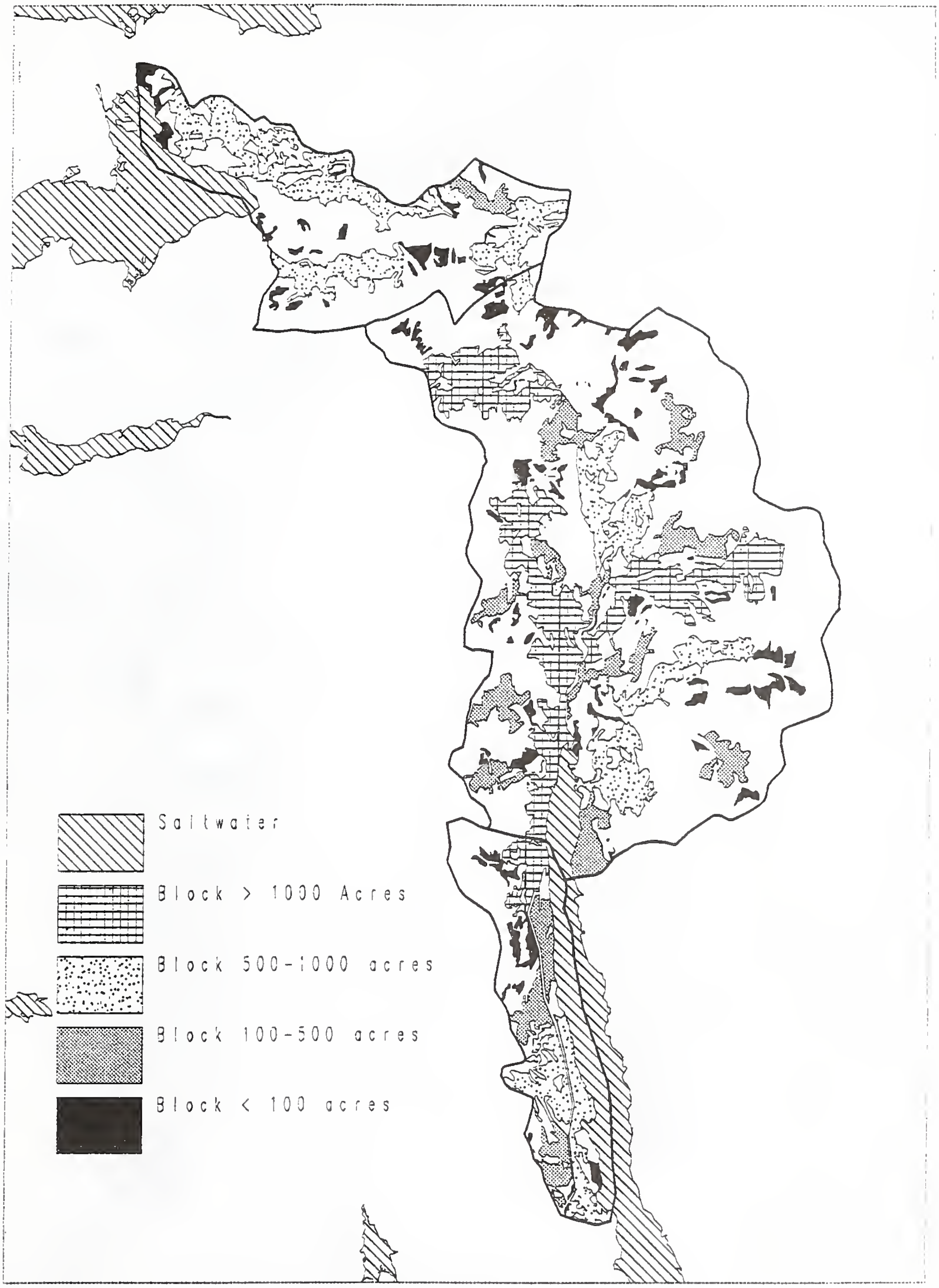


Figure Old Growth-7
Patch-size Effectiveness, Alternative 3

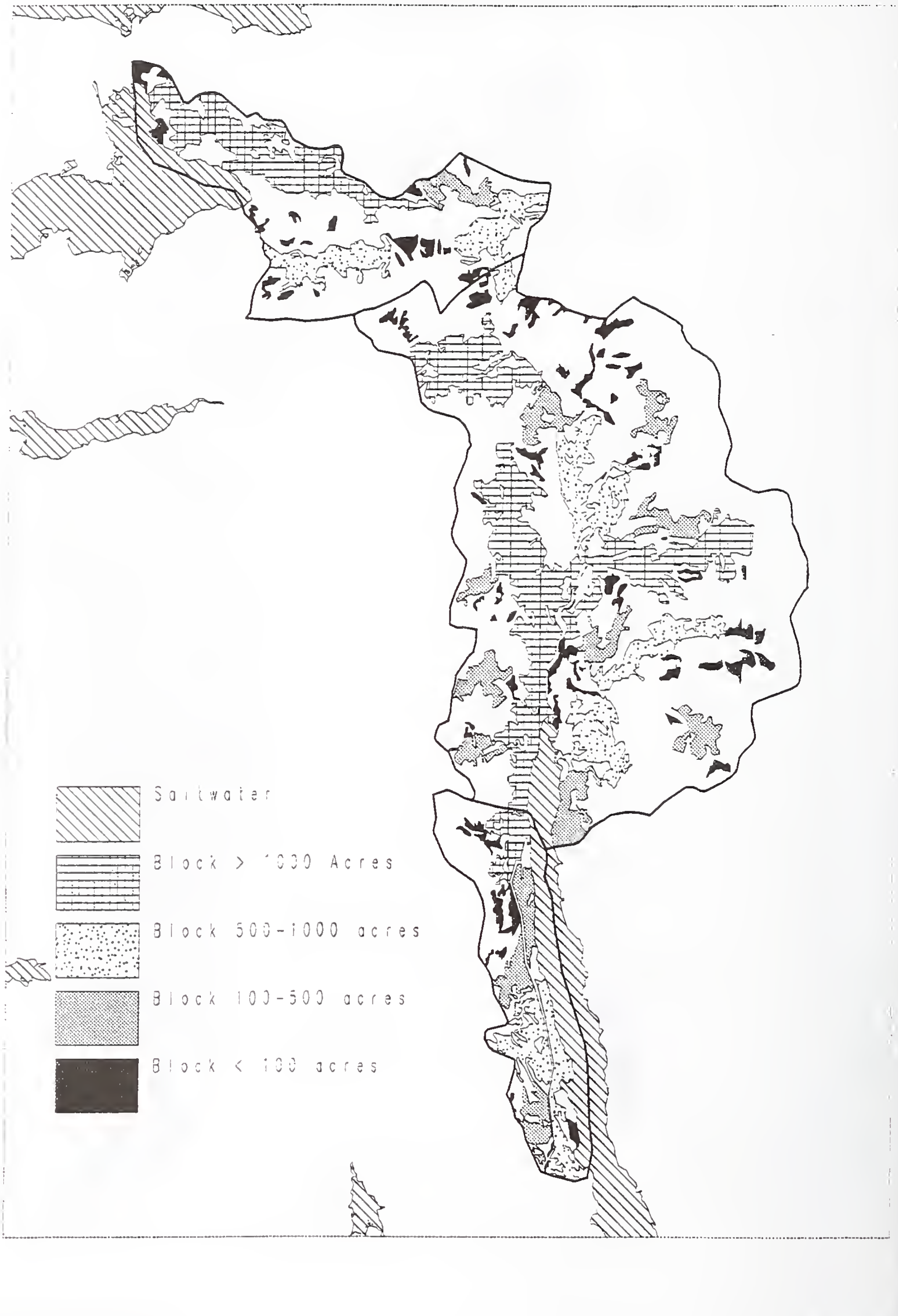


Figure Old Growth-8
Patch-size Effectiveness, Alternative 5

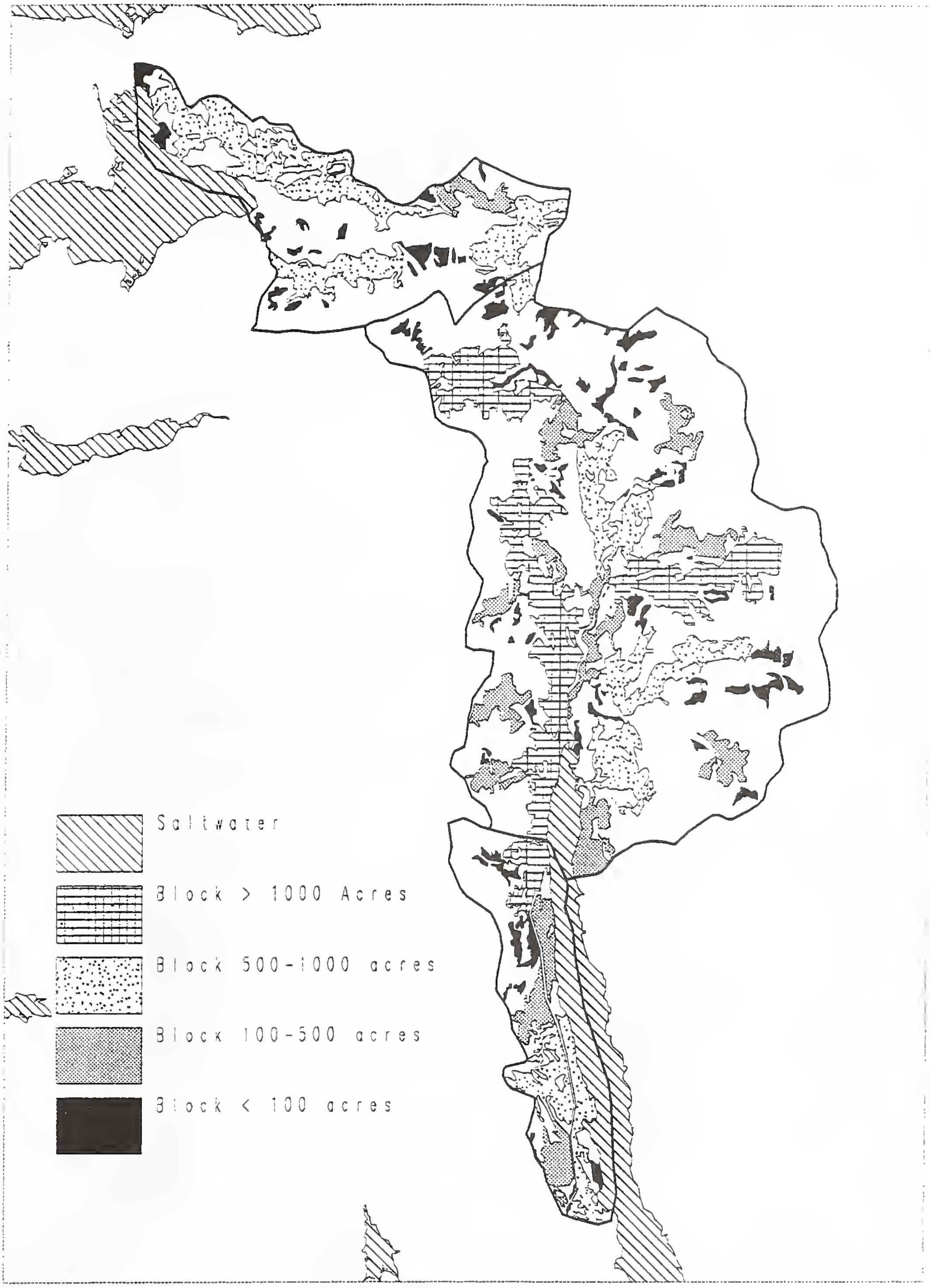


Figure Old Growth-9
Patch-size Effectiveness, Alternative 6

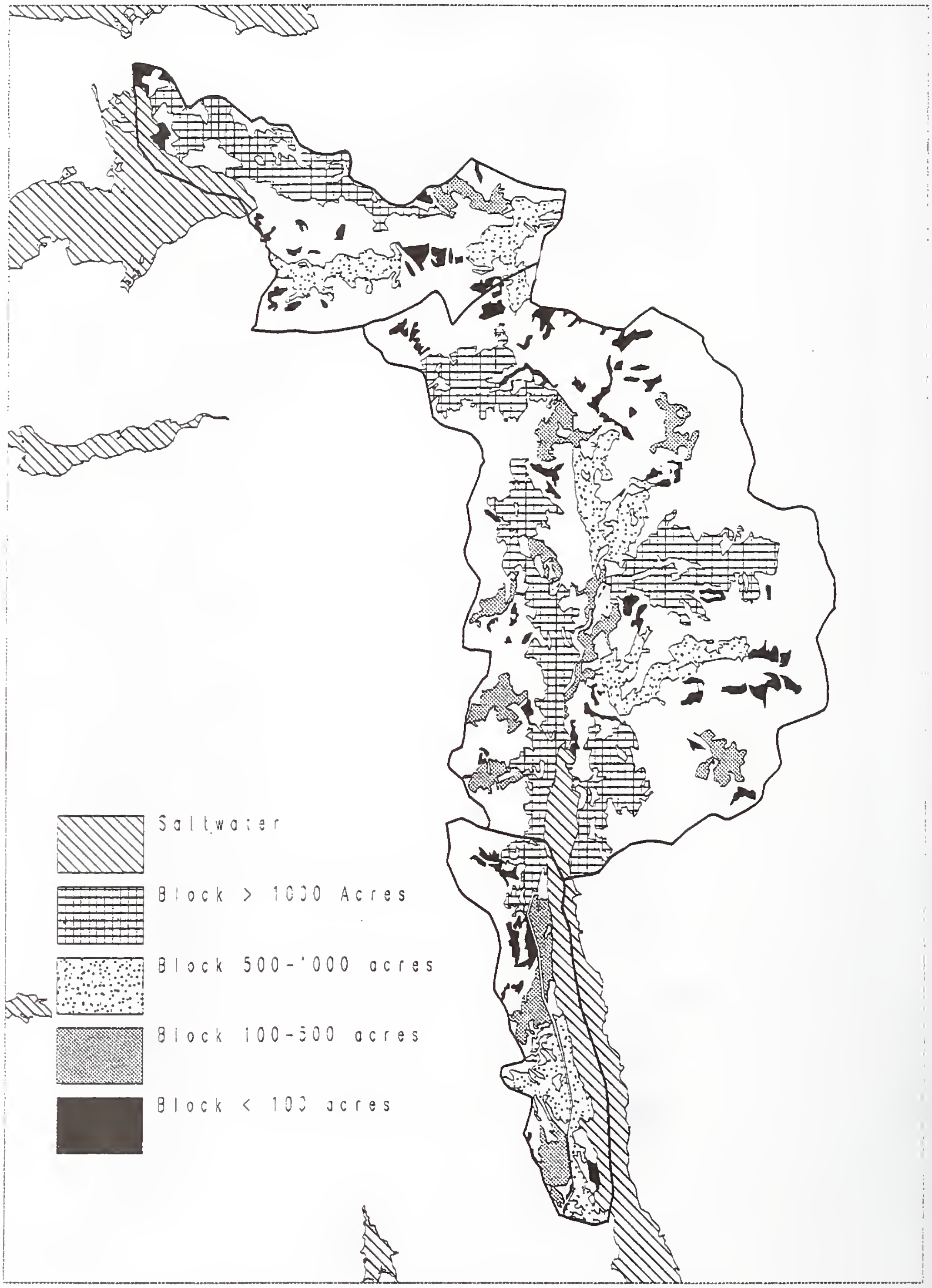
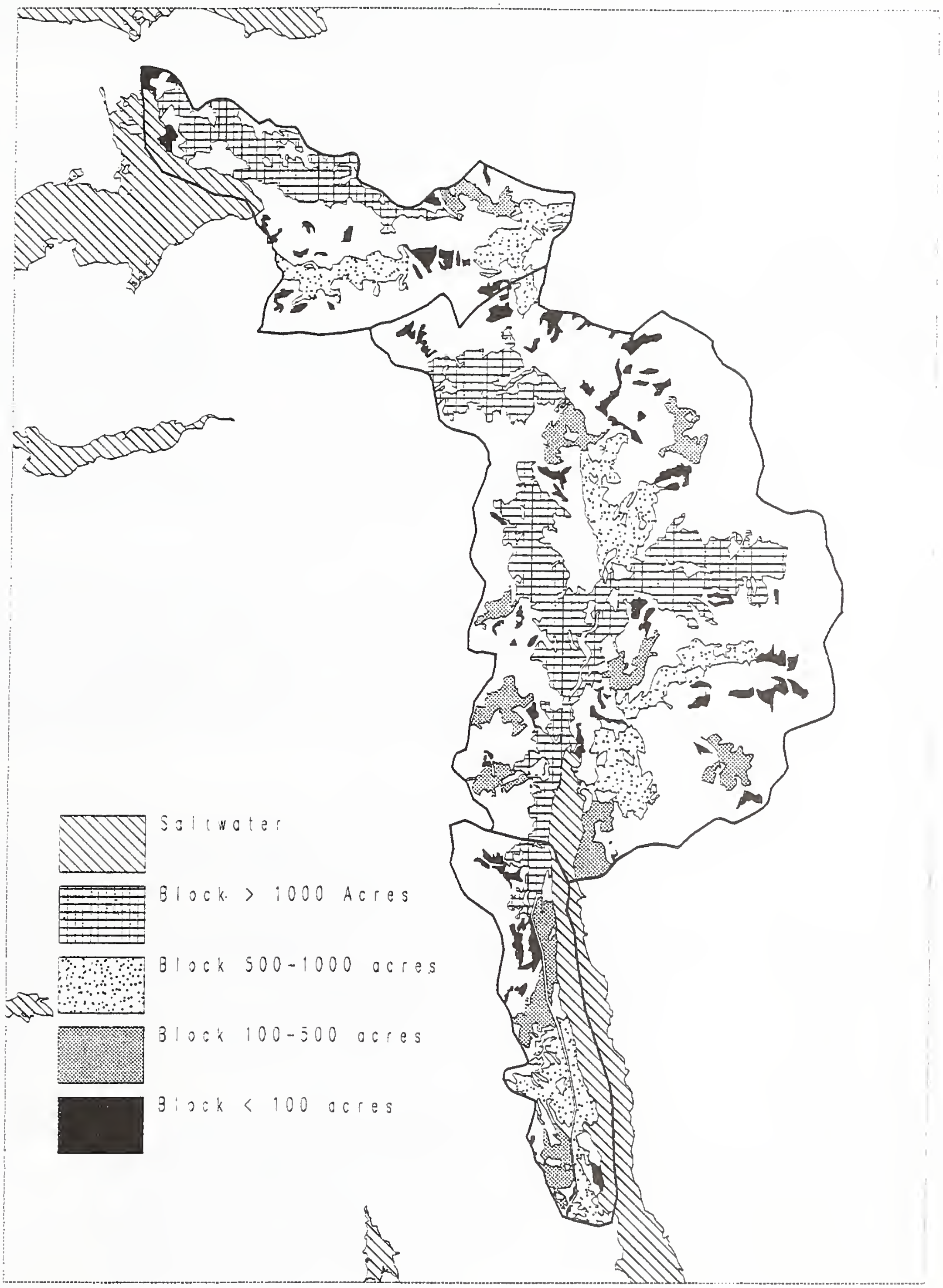


Figure Old Growth-10
Patch-size Effectiveness, Alternative 7



Effects of the Alternatives on Connectivity and Corridors

Carroll Creek has been identified by ADF&G and the US Fish & Wildlife Service as probably the most important wildlife corridor on Revilla Island. It contains low elevation old growth through the middle of the island. Figure Old Growth-2 shows the important travel corridors in the Upper Carroll Project Area. Alternative 1 maintains all corridors in the existing condition, Alternatives 3 and 7 maintain the Carroll Creek corridor by limiting timber harvest activities to the east side of Carroll Creek (which had already been impacted) and maintaining all the habitat on the west side in its current condition. Alternatives 2, 5, and 6 impact Carroll Creek the most.

Of the action alternatives, Alternative 7 harvests the least amount of identified corridors (one acre) and Alternative 2 harvests the most (73 acres). Alternatives 3, 5, and 6 harvest 25, 60, and 62 acres respectively, inside identified corridors. The harvest units are located along the edges of the corridors and therefore do not sever any of the corridors.

Effects of the Alternatives on Viable Populations of Wildlife

The wildlife viability challenge to planning was first addressed in 1990 when the Interagency Viable Population Committee (VPOP) systematically crafted a draft landscape conservation strategy based on habitat conservation areas to maintain viable well-distributed populations of old-growth associated species on the Tongass National Forest (Suring et al. 1993). At the request of the Alaska Regional Forester the Forest Service's Pacific Northwest Research Station (PNW), with the assistance of 18 nationally recognized scientists, conducted a review of the strategy. They concluded that the VPOP Strategy demonstrated a good awareness of modern concepts of wildlife management and conservation biology, but also commented that it would not ensure viability of all wildlife species (Kiester and Eckhardt 1994). Suring et al. (1994) provided recommendations to strengthen the VPOP Strategy in response to the PNW review comments. Some of the recommendations by Kiester and Eckhardt (1994) were incorporated into the TLMP RSDEIS (1996a).

The Upper Carroll Project maintains the options for implementation of such a population viability strategy by maintaining large old-growth habitat reserves such as the large old-growth blocks that exist within the Misty, Orchard Lake, and Naha LUD II areas (Suring et al. 1993). Since Alternatives 3, 5, and 6 will not be affecting the old-growth habitat reserves identified in the TLMP RSDEIS (1996a), the size and spacing requirements identified in that strategy will be met. Alternatives 2 and 7 harvest approximately 48.3 acres in the Naha block, but size and spacing requirements identified in TLMP RSDEIS (1996a) will still be met.

A small old-growth reserve of approximately 6,077 acres, consistent with the recommendations of the VPOP Committee recommendations, has been identified in the Upper Carroll Project (Carroll Creek Block). Approximately 739 acres of the Upper Carroll Block also functions as a travel corridor. Since Alternative 7 will not effect the small habitat reserve, this alternative presents the least risk to viable wildlife populations of the action alternatives. Alternatives 2, 3, 5, and 6, which harvest portions of the small habitat reserve, provide a slightly higher risk to population viability. Alternative 5 harvests the most acres within the small block, approximately 342 acres. Alternative 6 harvests the second most within the small block, 262 acres. Alternatives 2 and 3 harvest 226 and 25 acres, respectively, within the small old-growth block.

It is assumed that maintaining large old-growth blocks that exist within the Project Area and adjacent areas will contribute to the maintenance of well-distributed, viable populations of old-growth associated wildlife species.

Mapped Old-growth Habitat (Retention Areas)

Several projects within the Upper Carroll Project Area have previously identified and mapped habitat to be retained as old-growth habitat through the life of the project. The Shelter Cove Environmental Impact Statement (EIS) identified approximately 346 acres which is within the Upper Carroll Project Area and is mainly associated with the beach fringe along the west side of Carroll Inlet in VCU 746.

The 1984-89 Long-term Sale EIS identified a total of 4,801 acres of retention within the Upper Carroll Project Area; of this, 2,339 acres were from the normal commercial forest land (CFL) and 2,462 acres from the isolated CFL. Most of the old-growth habitat identified as retention within the normal CFL was located around the head of Carroll Inlet and along Carroll Creek. Most of the isolated retention was high elevation alpine area that was identified because of its value as summer range for deer and bear. Alternative 5 harvests the most retention located in normal CFL, 336 acres; Alternative 1 harvests the least, 155.8 acres. For the action alternatives, the total retention harvested ranges from 3.2 percent for Alternative 7 to 8.7 percent for Alternative 5 (Table Old Growth-7).

Table Old Growth-7
Amount of Old-growth Retention (1984-89 LTS EIS) Harvested by Alternative

	Alt. 1 (Existing)	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Isolated Retention Harvested	0	82.9	68.7	82.9	38.3	0.1
Normal CFL Retention Harvested	0	245.9	225.3	336	274.7	155.8
Total Harvested	**0**	**228.8**	**294**	**418.9**	**313**	**155.9**
Isolated Retention Remaining	2,462	2,379.1	2,393.3	2,379.1	2,423.7	2,461.9
Normal CFL Retention Remaining	2,339	2,093.1	2,113.7	2,003	2,064.3	2,183.2
Total Remaining	**4,801**	**4,472.2**	**4,507**	**4,382.1**	**4,488**	**4,645.1**
Percent Isolated Retention Harvested	0	3.4	2.8	3.4	1.6	0
Percent Normal CFL Retention Harvested	0	10.5	9.6	14.4	11.7	6.7
Percent Total Retention Harvested	**0**	**4.8**	**6.1**	**8.7**	**6.5**	**3.2**

SOURCE: Burns 1996, GIS database

Comparison of Alternatives

Based on old-growth habitat and patch-size effectiveness, Alternative 1 would do the most to preserve the natural biological diversity of the Project Area and maintain natural ecosystem processes. Of the action alternatives, Alternatives 3 and 7 maintain the most acreage in large old-growth patches. There is not much difference among action alternatives when considering patch-size effectiveness, although Alternative 2 has the most impact.

Table Old Growth-6 displays the results of patch-size effectiveness for deer, marten, red squirrel, hairy woodpeckers, and brown creepers (the Upper Carroll MIS with patch size criteria requirements). Note that none of the action alternatives are significantly different.

The species most effected by changes in patch-size effectiveness is the Sitka black-tailed deer. The results of patch-size effectiveness shows a decrease from 1995 conditions in the effectiveness of deer habitat. Habitat capability for deer in 1995 was 87.2 percent effective. The habitat capabilities for the action alternatives range from 73.7 percent effective for Alternative 2 to 78.7 percent effective for Alternative 7 (Table Old Growth-6).

Swan-Tyee Power Transmission Line

It is not anticipated that the Swan Lake-Lake Tyee Powerline Intertie Project will significantly increase cumulative effects that have already been analyzed for the Upper Carroll Project. The reason for this is that the proposed road location from Carroll Inlet to Neets Bay is the same as the proposed powerline location.

In a forested area such as the Upper Carroll Project Area, the primary effect of a transmission line on biodiversity stems from right-of-way cutting of large old-growth patches into smaller patches, with a resulting effect on wildlife habitat effectiveness. According to the Draft Environmental Impact Statement for the Swam Lake-Lake Tyee Intertie, neither alternative would have enough effect on old growth to significantly affect its wildlife habitat value or the viability of any wildlife population.

The Intertie Project would clear approximately 867 acres and 872 acres under Alternatives 3 and 2 respectively. Alternative 3 would reduce the acreage in large patches by six percent, while Alternative 2 would reduce acreage in large patches by 20 percent. This is for the entire Intertie Project Area. The Intertie would reduce the effectiveness of the Orchard Lake old-growth habitat reserve under option 2 of Alternative 2. The two alternatives traverse essentially the same habitat in the Upper Carroll portion of the project. The two alternatives would overlap much of the road right-of-way for the Upper Carroll Project. Therefore, the additional impacts are expected to be minimal.

Threatened and Endangered Species

Key Terms

Endangered—A species in danger of extinction throughout all or a significant portion of its range.
Threatened—A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
Species of Concern—A species or group of species being considered by the U.S. Fish and Wildlife Service for listing as endangered or threatened, but for which conclusive data is lacking on its biological vulnerability and degree of threat. Formally known as a Category 2 Candidate Species.
Sensitive—species (identified by the Regional Forester) whose population viability is of concern on national forests within the region, and which may need special management to prevent their being placed on State or Federal threatened and endangered species lists.
Haul Out—area of large, smooth, exposed rocks used by seals and sea lions for resting and pupping.

Affected Environment

Threatened or Endangered Species

Federally listed threatened and endangered species are those plant and animal species formally listed by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS), under the authority of the Endangered Species Act of 1973, as amended. Candidate species are those being considered for listing as threatened or endangered by the USFWS and NMFS. Species of concern are those species (formally known as Category 2 Candidate species) for which there is information indicating the species might qualify for endangered or threatened status, but for which further evaluation is needed. The State of Alaska has an Endangered Species Law which authorizes the commissioner of the Alaska Department of Fish and Game (ADF&G) to list Alaska endangered species. The Regional Forester can also designate species as "Sensitive."

Plants

No plant species known to occur in the Project Area have been determined threatened, endangered, or candidate. Several sensitive plant species have been discovered during botanical surveys of the Project Area.

Marine Mammals

Humpback whales ***(Megaptera novaeangliae)*** and Steller sea lions ***(Eumetopias jubata)*** are occasionally found in waters bordering the Project Area (Pennoyer 1992).

Humpback Whale

The local distribution of humpbacks (listed by NMFS as Endangered) in Southeastern Alaska appears to be correlated with the density and seasonal availability of prey, particularly herring *(Clupea harengus)* and euphausiids (shrimp-like crustaceans). Important feeding areas include Glacier Bay and adjacent portions of Icy Straight, Stephens Passage/Frederick Sound, Seymour Canal, and Sitka Sound. Other areas of Southeastern Alaska may also be important for humpbacks and need to be evaluated. These include Cape Fairweather, Lynn Canal, Sumner Strait, Dixon Entrance, the west coast of Prince of Wales Island, and offshore banks such as the Fairweather Grounds; none of which are within the Project Area.

Steller Sea Lion
The Steller sea lion (listed by NMFS as Threatened) ranges from Hokkaido, Japan, through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, Gulf of Alaska, Southeast Alaska, and south to central California. Currently, information on Steller sea lion population trends in Southeast Alaska is limited. However, available information suggests that Steller sea lion populations are stable in Southeast Alaska. There are no known Steller sea lion haul out areas identified in the Project Area, although they may occasionally be seen swimming in Behm Channel.

Fish
No threatened or endangered fish species are found in the freshwater river systems in the Project Area. Two threatened species, the Snake River fall Chinook salmon (*Oncorhychus tshawytscha)* and the Snake River spring/summer Chinook salmon, and one endangered species, the Snake River sockeye salmon (*O. nerka)* may be present in the general vicinity in saltwater during the marine rearing period of their life cycle. The presence of these Pacific Northwest salmon is not documented for these waters, but their occurrence is possible.

Other Wildlife
The endangered American peregrine falcon may migrate through the Upper Carroll Project Area, as well as the Eskimo curlew and the Aleutian Canada goose. The Arctic peregrine falcon was delisted in 1994, but the Endangered Species Act requires that the species be monitored for five years following delisting. No other endangered or threatened wildlife species are known to occur in the Project Area (Holmberg 1992).

Species of Concern and Sensitive Species

Federally listed fish and wildlife Species of Concern occurring in Southeast Alaska include Alexander Archipelago wolf, Marbled murrelet, Kittlitz's murrelet, Queen Charlotte goshawk, Harlequin duck, Olive-sided flycatcher, bull trout , and spotted frog.

There is one plant species which is classified as a Species of Concern *(Carex lenticularis var. dolia*) which is suspected to occur in the Ketchikan Area of the Tongass National Forest. Of 22 Forest Service listed sensitive plant species, only 11 are known or suspected to occur in the Ketchikan Area of the Tongass National Forest (goose-grass sedge, edible thistle, Davy mannagrass, Wright filmy fern, truncate quillwort, calder lovage, choris bog orchid, bog orchid, loose-flowered bluegrass, straight-beak buttercup, and Queen Charlotte buttercup).

The Trumpeter swan is a Forest Service sensitive species that is known to occur in the Upper Carroll Project Area. Also, the osprey and Peale's peregrine falcon are Sensitive species that may occur in the Upper Carroll Project Area.

Species of Concern

Alexander Archipelago Wolf
The Alexander Archipelago wolf is a small subspecies of the gray wolf (Goldman 1937, Pederson 1982), similar in appearance to the Vancouver Island wolf.

The primary food of most Southeast Alaskan wolves is deer (Wood 1990, Person 1993). Beaver, mountain goat, and moose are also primary prey in some mainland areas and spawning salmon are fed on when available (Wood 1990).

Wolves are common on Revillagigedo Island. A 1984-85 wolf study (Smith et al. 1985) suspected that there were eight packs of wolves on Revillagigedo Island with an early winter population of 29 to 51 and 26 to 37 in spring.

Many studies have shown that wolf abundance may be correlated with road density (Theil 1985, Jensen et al. 1986, Mech et al. 1988, Fuller 1989). In one study, wolves generally were not present where the density of roads used by humans exceeds 0.93 mi./sq. mi. (0.58 km/sq. km) (Mech et al. 1988). However, other work has suggested that wolves could exist in areas with higher road densities if these areas are adjacent to roadless areas (Mech et al. 1988). The primary threat of high road densities is the increased access of humans who kill wolves by shooting, snaring, or trapping (Van Ballenberge et al. 1975, Mech 1977).

Based on application of the Tongass Habitat Capability Model for the gray wolf, habitat capability declined about 40 percent in the Project Area between pre-logging and existing conditions. This decline is directly related to a reduction in deer habitat capability associated with conversion of old-growth forest to young second growth. Accompanying this decline has been an increase in road density associated with logging activities. Road density is currently approximately 0.2 mi./sq. mi. across the Project Area; however, none of these roads are connected to the Ketchikan road system and most of the roads are not drivable because of removed culverts and conversion to brush/trees.

Marbled Murrelet

The marbled murrelet is a robin-sized seabird that is found throughout the North Pacific; the North American subspecies ranges from Alaska's Aleutian Islands to central and occasionally southern California. The marbled murrelet feeds in near-shore ocean feeding areas, inland saltwaters, and occasionally inland freshwater lakes. The bird feeds below the water's surface on small fish and invertebrates.

Based on at-sea surveys, 85 percent of the estimated 300,000 marbled murrelets in North America occurs in Alaska, with approximately 96,000 in the Alexander Archipelago (Ralph et al. 1995). Agler et al. (1995) determined the early-summer, on-water population (equal to or less than 95 percent CI) in Southeast Alaska to be 434,129 (equal to or less than 166,525). Agler et al. (1995) shows the density in Carroll Inlet at less than ten birds per square kilometer, while the average for marbled and Kittlitz's murrelets together throughout Southeast Alaska was 19.4 birds per square kilometer.

The marbled murrelet is currently listed as a Species of Concern in Alaska. The U.S. Fish and Wildlife Service has listed the marbled murrelet as threatened in Washington, Oregon, and northern California. In the Pacific Northwest and Southeast Alaska, the bird normally nests in old-growth forests; however, a ground nesting marbled murrelet has been discovered on Prince of Wales Island (Thorne Bay Ranger District 1993).

Marbled murrelet habitat requirements are not well established for Southeast Alaska, and there is a need for research on both nesting and foraging habitat requirements as well as mortality factors such as oil spills, fishing nets, and predation. However, the available information indicates that habitat for regional marbled murrelet populations is probably adequate.

The 1996 TLMP RSDEIS (1996a) includes standards and guidelines for leaving a 600 foot windfirm buffer around all nests discovered, so that the nesting site can be studied in order to gain a better understanding of the nesting habitat requirements of marbled murrelets in Southeast Alaska.

Morning counts for marbled murrelets were conducted at three sites along Carroll Creek and one site along Orchard Creek. The surveys along Carroll Creek were conducted on July 7-9, 1993. Only one detection (approximately two birds) was heard at the three sites. The Orchard Creek site was surveyed August 5, 1993, with 61 detections, mostly auditory.

Kittlitz's Murrelet

Kittlitz's murrelet is a small seabird belonging to the Alcidae family. Information is limited on the natural history of this species. Kittlitz's murrelet is distributed near glacial waters from Point Barrow south to at least Glacier Bay, most commonly from Cape Prince of Wales south to Glacier Bay from spring through fall (Robbins et al. 1983, Peterson 1990). Kittlitz's murrelet does not occur as far south as the Upper Carroll Project Area.

Winters are spent feeding in off shore pelagic waters. Kittlitz's murrelet forages on crustaceans in inshore marine waters during the breeding and nesting season in Alaska. Nests are generally located inland on the ground above timberline in coastal mountains at the base of north-facing slopes. Nesting may occur on unvegetated glacial moraines, grassy ledges of island sea cliffs, and barren ground coasts (Ehrlich et al. 1988). One egg per clutch is laid on the bare ground amid lichen-covered rocks. Young Kittlitz's murrelets born at inland nests are believed to swim downstream to reach the sea.

Northern Goshawk

The goshawk is a raven-sized raptor associated with forests having tall trees and dense canopies. These features allow goshawks to hunt beneath the tree canopy, and to capture prey before the prey escapes into the trees or shrub layer. The dense canopy in tall trees fosters a more abundant prey species population and provides a microclimate suitable for nesting. Goshawks forage over home ranges that are typically 6,000 to 8,000 acres, though home range may be twice that size in fragmented forests (C. Crocker-Bedford 1991).

The northern goshawk has been listed as a Species of Concern for all of its range, including the Queen Charlotte subspecies which is present in Southeast Alaska. A status review was completed, and a decision was made that listing the species as threatened or endangered at this time is not warranted (U.S. Fish and Wildlife Service News Release 1995).

On August 18, 1992, Interim Guidelines for Goshawk Habitat Management were adopted by the USDA Forest Service Region 10. A review and evaluation of the guidelines is in progress.

The Preferred Alternative in the 1996 TLMP RSDEIS contains the following guidelines for preserving habitat around all confirmed and probable nests. The guidelines consist of two components:

> *Nest Stand*—Maintain an area of at least 25 acres around the nest tree and attempt to include prey handling areas, perches, and roosts. No vegetative manipulation or new road construction is permitted. Existing roads may be maintained. Continuous disturbance is not permitted within the surrounding 600 feet from March 15 to August 15. Activity restrictions may be removed if the nest becomes inactive or unsuccessful.
>
> *Nesting Habitat*—Maintain an area of not less than 75 acres surrounding the nest stand (total management area of 100 acres). Include inactive nest stands, hiding cover, and foraging opportunities for young goshawks. No commercial timber harvest is permitted within the Nesting Habitat. New road construction is permitted (outside the Nest Stand) if no other reasonable roading alternative exists.

Inventories were conducted in the Carroll Creek, Neets Creek, and Orchard Creek drainages during 1993, 1994, and 1995. No goshawk nests were found. Goshawk calls were broadcast from 275 stations with no response. Radio tracking of goshawks that nest in the Traitors Creek area reveal that those goshawk do spend some time foraging in the Upper Carroll Project Area.

On May 1, 1996, a pair of goshawks was observed in the Project Area. No nest was found, but vocalizations were heard that indicated a possible food transfer between a male and female goshawk. This suggests the probability of a nest nearby. The observation was made in the west fork of Carroll Creek near FEIS Harvest Unit No. 5.

Harlequin Duck

The harlequin duck's range is divided into two distinct regions: eastern and western. The eastern range embraces Iceland, parts of Greenland, and Labrador, with the winter range extending as far south as New Jersey. The western range includes northeast Siberia west to the Lena River, east to the Kamchatka Peninsula and the Commander Islands, and north to the Arctic Circle, then across the Bering Sea to the Aleutian Island, much of the interior Alaska, south to northwest Wyoming and central California (Bellrose 1980). In Alaska, the harlequin duck as been reported as a fairly common year-round resident, and at one season or another, has been recorded over much of the State except the Arctic coast (Gabrielson and Lincoln 1959).

Available evidence indicates that the species breeds locally over much of southern Alaska, probably the Aleutians, and north to Anaktuvuk Pass. Ornithologists who have worked during the spring and summer months in the Alexander Archipelago and other parts of Southeast Alaska have commented upon the numbers of these ducks, frequently summarizing their observations by stating that they were common or abundant (Gabrielson and Lincoln 1959).

Harlequins nest along inland fast-moving rivers and streams, usually within six feet (but up to 60 feet) of water (DeGraaf et al. 1991). The nest site generally has shelter overhead: a recess in a streambank or among rocks, or under shrubs, trees, or stranded debris. Occasionally the nest is in an open area or even on a stream bar, but under shrubbery or other low vegetation. During the winter the harlequin duck is common to abundant in the coastal waters of Southeast Alaska, Prince William Sound, Cook Inlet, the bays of the Alaska Peninsula, the Aluetians, and the Pribilofs (Gabrielson and Lincoln 1959). Preferred winter habitat is reported to be areas along surf-pounded rocky coasts, rather than sheltered bays and fjords, where water is one to two fathoms deep and turbulent, and where bottom fauna abounds (Palmer 1975). Harlequins feed on molluscs, crustaceans, insects, fish, and echinoderms (Bellrose 1980).

Olive-sided Flycatcher

The olive-sided flycatcher breeds in wooded regions from central Alaska east to Newfoundland and south to northern Baja California and central Arizona in the west, central Minnesota and northern Michigan in the central states, and North Carolina and Tennessee in the east. The species winters in South America.

It inhabits open coniferous forests and forest edges along lakes, streams, and muskegs (Bent 1942). Godfrey (1979) described the habitat of the species as "burntlands with standing dead trees, bogs. Lakeshore with water-killed trees, lumbered areas, and other clearings in woodlands." DellaSala et al. (1994) noted that the species was often observed using habitats associated with lakes and muskegs during a breeding bird study on central Prince of Wales Island.

Spotted Frog

The spotted frog occurs in or near freshwater including marshy ponds, streams, and lakes as high as 9,842 feet (3,000 meters) in parts of its range (Stebbins 1985). This species is believed to range from south of the Taku River to other transboundary rivers and some islands of Southeast Alaska and British Columbia (Holmberg, 1992). Spotted frogs have been documented in the Stikine River basin (Waters 1992), and most recently have been observed by USFWS in the Unuk River. Several ponds and streams in the Carroll Creek drainage were checked for the presence of the Spotted Frog and none were found. Numerous rough-skinned newts *(Taricha granulosa)* were found and one pond was found to have western toads *(Bufo boreas)*. Large numbers of toads have been reported near the Carroll Creek estuary.

Bull Trout

Although the range of bull trout in the contiguous United States has become greatly restricted in recent times (Goetz as cited in Hass and McPhail 1991), it still exists as far south as the Oregon-California border, north through Canada, and in the Yukon River system in Alaska (Hass and McPhail 1991). Bull trout are largely confined to interior regions throughout their distribution, only reaching the Pacific coast in the Puget Sound area of Washington and in the Fraser River drainage in British Columbia (Hass and McPhail 1991). Since bull trout have only been observed in the drainages of major interior river systems, it is not likely that bull trout occur in the streams of the Upper Carroll Project Area.

Goose Grass Sedge *(Carex lenticularis var. dolia)*

This sedge is known to occur in the coastal mountains of Alaska and British Columbia and the Rocky Mountains from Jasper, B.C., south to Glacier National Park, Montana. Its range in Alaska is limited to the alpine of coastal Southcentral and Southeast Alaska and the Aleutian Islands. There are nine documented occurrences in Alaska (Forest Service 1994), in Southeast, at the Mendenhall Glacier, Bailey Bay on Cleveland Peninsula, and the Chickamin Glacier. This species is not known to be found within the Project Area. Its habitat is wet alpine meadows and bare edges of snowbeds.

Sensitive Species

Trumpeter Swan

The trumpeter swan is classified as a sensitive species in Forest Service Region 10. The swan is the largest waterfowl species in the world. Its present range is only a vestige of the once vast region of North America that it frequented in both summer and winter (Bellrose 1980). Trumpeter swans breeding in Alaska spend the winter along the Pacific Coast from the Alaska Peninsula to the mouth of the Columbia River where they take advantage of open waters of saltwater estuaries and freshwater lakes and rivers. Trumpeter swans are present in the Project Area primarily during the fall and early spring migration periods and during winter.

Carroll Creek estuary, Neets Bay, and Orchard Lakes area are resting stops/wintering areas for swans in the Project Area.

Peale's Peregrine Falcon

The Peale's Subspecies of the peregrine falcon (*Falco peregrinus pealei)* nests on the outer islands west of Prince of Wales Island. This species is not listed as endangered or threatened, but is covered by a provision of the "similarity of appearance" which broadens the scope of protection for all peregrine falcons. The nest distribution of this subspecies is closely associated with large seabird colonies, and seabirds are believed to be the major prey of the falcon.

Osprey
Ospreys occur in low numbers in Southeast Alaska during the spring/summer nesting period from late April through August. They are believed to overwinter in Mexico and Central America. The closest known nest is over 40 miles to the north. Nest trees in these areas consist of broken-top spruce (live or dead) and snags of western hemlock in hemlock/spruce forest types near streams or coastal beaches. Historically, the Southeast Alaska population of osprey appears to have remained stable but low. It is unknown why osprey occur in relatively low numbers in this region, but available nest sites and foraging areas do not appear to be limiting factors.

Edible Thistle *(Cirsium edule)*
This regionally endemic thistle species is distributed primarily along coastal Oregon, Washington, and British Columbia and barely reaches southern most Southeast Alaska. The only documented occurrence is near Hyder in interior Southeast Alaska near the border of Canada (Forest Service 1994). It is unknown whether this species occurs in the Project Area. Its habitat in Alaska is characterized as wet meadows and open woods along glacial streams.

Davy Mannagrass *(Glyceria leptostachya)*
This grass species is distributed from Southeast Alaska to central California. Its distribution in Alaska is limited to central and southern Southeast Alaska. It is known to occur in only two documented locations: near Wrangell Alaska and on Prince of Wales Island, however, it is easily overlooked and likely to be more widespread in Southeast (Forest Service 1994).

During botanical surveys in the Project Area, several specimens were collected that appeared to be *Glyceria leptostachya*. These specimens have been sent to other botanists for consensus. This species was found in a muskeg in the vicinity of FEIS Harvest Unit 21.

Wright Filmy Fern *(Hymenophyllum wrightii)*
This fern species occurs in coastal areas of Southeast Alaska and British Columbia. Three sightings have been documented in Alaska and are limited to Biorka and Mitkof Islands (Forest Service 1994). It is unknown if the species occurs in the Project Area. This species appears to prefer humid shaded boulders, cliffs, tree trunks, and damp woods in the wettest maritime regions. In Alaska, it has been found in small populations on the base of trees and rock outcrops in damp woods.

Truncate Quillwort *(Isoetes truncata)*
This rooted aquatic species is known from a few widely isolated populations on Vancouver Island and Southcentral Alaska on the Copper River Delta (Forest Service 1994). It is unknown if this species occurs in the Project Area. Truncate quillwort occurs in shallow water of lakes and streams.

Calder Lovage *(Liqusticum calderi)*
This plant species occurs in British Columbia and southcentral and Southeast Alaska. Documented occurrences in Alaska are limited to two disparate areas on Kodiak Island and Dall Island (just west of Prince of Wales Island) in Pleistocene refugia on limestone substrate (Forest Service 1994). It is unknown if this species occurs in the Project Area. Calder lovage occurs on rocky cliffs, open boggy or rocky slopes, and edges of coniferous forests. In Alaska it is known from alpine meadow habitats and edges of subalpine mixed coniferous forest.

Choris Bog Orchid *(Platanthera chorisana)*
In Alaska, this bog orchid species is limited to the Aleutian Islands and southern coastal areas (Forest Service 1994). Recent botanical surveys on Revillagigedo Island have revealed a minimum of 12 populations of this species, six of them within the Upper Carroll Project Area. This species has been found in the vicinity of FEIS Harvest Units 20 and 59, and adjacent to a small pond in the Carroll Creek drainage. This species has also been found on Revillagigedo Island in the Mahoney Lakes area and elsewhere. With the increasing number of observations, it is possible that this species is not as rare as previously thought.

Bog Orchid *(Platanthera gracilis)*
This species of bog orchid is limited to a small geographic range in southern most Southeast Alaska and adjacent British Columbia (Forest Service 1994). Two documented sightings have been made in Alaska near Pearse Canal and on Dall Island. It is unknown if this species occurs in the Project Area. This plant occurs in wet open meadow habitat. It is undetermined whether the taxon of this species is distinct; if it is not, it may be more common than previously believed (Forest Service 1994).

Loose-flowered Bluegrass *(Poa laxiflora)*
The distribution of this grass species is scattered between Southeast Alaska and Oregon. Seven sightings have been documented in Southeast Alaska near Hoonah, Sandborn Canal at Port Houghton, and Admiralty Island (Forest Service 1994). It is not known if this species occurs in the Project Area. Loose-flowered bluegrass is associated with moist, open lowland woods and open-forest meadows.

Straight-beak Buttercup *(Ranunculus orthorhynchus)*
This species of buttercup is distributed from coastal southern Southeast Alaska to adjacent British Columbia and Vancouver Island (Forest Service 1994). The closest documented occurrences to the Project Area include near Loring and Yes Bay. It is unknown if the species occurs in the Project Area. It occurs in moist, open lowland meadows and other moist open habitats.

Queen Charlotte Butterweed *(Senecio moresbiensis)*
This species of butterweed is limited to the Queen Charlotte Islands of British Columbia and to disjunct populations in southeastern Alaska and northwestern Vancouver Island (Forest Service 1994). Five occurrences have been documented in Alaska on Prince of Wales, Coronation, and Dall Islands. It is not known if this species occurs in the Project Area. Queen Charlotte Butterweed occurs in shady wet areas and bogs of montane to alpine habitats, to open, rocky or boggy slopes, and in open, rocky heath or grass communities (Douglas 1982 in Forest Service 1994).

Effects of the Alternatives

Proposed actions in each of the alternatives are not anticipated to adversely affect, directly, indirectly, or cumulatively, the humpback whale, Steller sea lion, American peregrine falcon, Aleutian Canada goose, or the Eskimo curlew. A *Biological Assessment* is included in Appendix D.

Threatened or Endangered Wildlife Species

Humpback Whale

Two types of boat activity associated with LTFs, log raft towing and recreational boating by workers, may have an effect on whales. Log raft towing frequency would vary between camps, seasons, and years; a general average may be about once a week during the working season (U.S. Forest Service 1989-94 Operating Period for the KPC Long-term Contract). The speed and direction of tugs and recreational boats may affect whale behavior; however, log raft towing routes are generally well established, and adverse effects from log raft towing have not been documented.

Recreational boating activity would vary between seasons and years from the community of Ketchikan. The effect of such recreational activity on whales would depend on factors such as size of the bay, depth of the water in the bay, number of boats, and individual behavior responses of the whales. There currently is not a quantifiable way to estimate these possible effects.

No direct or indirect effects on whales from implementation of forest management activities are anticipated. Forest-wide Standards and Guidelines have been developed and are included in the TLMP RSDEIS (1996) to prevent and/or reduce indirect effects due to Forest Service permitted or approved activities. The following standards and guidelines have been developed for application on all Forest Service permitted or approved activities.

- Provide for the protection and maintenance of whale habitats.

- Ensure that Forest Service permitted or approved activities are conducted in a manner consistence with the Marine Mammal Protection Act, the Endangered Species Act, and National Marine Fisheries Service regulations for approaching whales, dolphins, and porpoise. "Taking" of whales is prohibited; "taking" includes harassing or pursuing or attempting any such activity.

Steller Sea Lion

Proposed actions in each of the alternatives are not anticipated to adversely affect directly, indirectly, or cumulatively, Steller sea lion populations. No areas within the Project Area have been listed by NMFS as critical habitat.

Forest-wide Standards and Guidelines have been developed to prevent and/or reduce indirect effects of harassment or displacement of marine mammals due to Forest management activities. These guidelines will be followed.

Fish
According to the National Marine Fisheries Service (letter to USFS, May 10, 1996), the presence of Pacific Northwest salmon is not documented for these waters, but their occurrence is possible. No significant impacts are anticipated because none are found in any freshwater river system in the Project Area. Impacts to saltwater fisheries are mainly associated with log transfer facilities and log storage and towing. There is a limited potential for effects to occur while fish are in the saltwater life stages in the area. Due to the infrequent occurrence of Snake River sockeye salmon, Snake River spring/summer chinook salmon, and fall chinook salmon in the Project Area, no adverse effect on their population by any of the alternatives is anticipated.

American Peregrine Falcon
The American peregrine falcon occurs in Southeast Alaska only during migration. During migration through Southeast Alaska, the abundance of prey species will most likely be the primary habitat factor affecting peregrine falcons. In coastal areas of Washington, the primary prey species were shorebirds and waterfowl species. Passerine birds have also been identified in their diet. It is assumed that food sources would be similar for coastal Alaska.

Forest-wide Standards and Guidelines have been developed for protecting seabird rookeries and waterfowl concentrations (USDA Forest Service, TLMP RSDEIS, 1996a). A wide variety of passerine (perching and song) birds will be available from the numerous open and forested communities under all alternatives associated with the Upper Carroll Project. No adverse effect on American peregrine falcon populations is anticipated with any of the alternatives.

Aleutian Canada Goose
The Aleutian Canada goose is not primarily associated with Southeast Alaska. Although migration patterns in Alaska are not well known, Aleutian Canada geese may occur in Southeast Alaska as migrants. Due to the limited use of the Project Area by Aleutian Canada geese, no adverse effect on their population by any of the alternatives is anticipated.

Eskimo Curlew
The Eskimo curlew is primarily associated with western and northern Alaska. The Eskimo curlew is rare and not typically found in Southeast Alaska, but it may occur as a migrant. Due to the limited use of the Project Area by Eskimo curlew, no adverse effect on their population by any of the alternatives is anticipated.

Species of Concern

Arctic Peregrine Falcon
The Arctic peregrine falcon is primarily associated with the area north of the Brooks Range and Seward Peninsula. It is highly migratory, wintering as far south as northern Argentina (Ambrose et al. 1988). It occurs in Southeast Alaska only during migration periods. As described for the American peregrine falcon, no effect on the population or habitat of the Arctic peregrine falcon is anticipated due to any Upper Carroll action alternative.

Marbled Murrelet
All action alternatives will harvest stands capable of providing nesting habitat (old-growth forests) for marbled murrelets. Table Wildlife-6 in the Wildlife section of this chapter shows that Alternatives 2, 3, 5, 6, and 7 harvest three to ten percent of the commercial old-growth forest in the Project Area.

Based on current information, a reduction in available nesting habitat may occur; therefore, marbled murrelets may be affected. However, because of the many large unroaded blocks of habitat that exist in and adjacent to the Project Area (Misty Fiords National Monument —2,136,000 acres; Cleveland Peninsula—250,000+ acres; Orchard Lake—10,000 acres; and the Naha River area—20,000 acres), the regional population of marbled murrelets is not anticipated to be adversely affected. Any nests located during field reconnaissance or unit layout will be protected from timber harvest and blowdown using the management guidelines in effect at that time. The TLMP RSDEIS (1996a) proposes using a 600-foot buffer around each nest. Disturbance activities would be minimized during the nesting season and the buffer zone would be maintained and monitored for at least two nesting seasons following discovery. If the nest remains inactive for more than two years, the buffer protection may be removed.

In areas with timber harvesting, the amount of nesting habitat for marbled murrelets will be reduced. Murrelets would not likely re-occupy a clearcut area until the regenerating forest attained a suitable degree of complexity and individual trees attained a suitable size, perhaps no sooner than 150 years (*Assessment of the Marbled Murrelet,* TLMP RSDEIS, 1996a). It is not known what the actual effects of timber harvest will be, other than the total amount of habitat will be reduced. Fragmentation or increased edge effects may also reduce habitat capability for marbled murrelets.

Even if the breeding population were reduced in proportion to the percentage of productive old-growth forest harvested under the action alternatives (three to ten percent), the population in the Upper Carroll Assessment Area would still be strong. Therefore, the effect on the huge Southeast Alaska population (434,000 plus or minus 166,000) would be negligible. Therefore, the Upper Carroll Project may effect individual marbled murrelets, but will have no effect on population viability.

Kittlitz's Murrelet
No observations have been made of this species in the Upper Carroll Project Area and it does not appear that this species is dependent on old-growth forests for nesting habitat. The Kittlitz's murrelet population for Southeast Alaska as a whole is strong; calculated at 253,000 from Agler et al. (1995). Therefore, the Upper Carroll Project is not expected to affect Kittlitz's murrelets.

Northern Goshawk
There have been two confirmed goshawk nests near the Upper Carroll Project Area, one near Margaret Lake and the other in the Traitors Creek drainage. Goshawks are extremely difficult to locate, so it is possible that there could be a breeding territory in the Upper Carroll Project Area. All action alternatives will harvest stands capable of providing nesting habitat (old-growth forests) for goshawks. Table Wildlife-6 in the Wildlife section of this chapter shows that Alternatives 2, 3, 5, 6 and 7 harvest between three and ten percent of the commercial forest in the Project Area; therefore, goshawks may be affected.

Indications of a possible nest were observed on May 1, 1996 near FEIS Harvest Units 4, 5, and 6. Alternative 2 harvests Units 5 and 6. Alternative 5 harvests all three of the units. Alternative 6 harvests Units 4 and 5. These three alternatives pose the greatest risk of impacting nesting goshawks. Any goshawk nests found during field reconnaissance or unit layout will be protected from harvest, by implementing the current project specific mitigation measures (see Chapter 2 - Mitigation) or any subsequently adopted Forest Plan guidelines.

Harlequin Duck
Nesting habitat for the harlequin duck occurs along in-land rivers and streams. Riparian habitats along all rivers and streams in the Project area will be managed according to Riparian and Lake Standards and guidelines in the TLMP RSDEIS (1996a).

Nesting habitat requirements are expected to be maintained. Winter habitat occurs in the marine environment, in areas of high surf and rocky beaches. A small chance exists that the Upper Carroll Project could effect a few individual harlequin ducks. Still, it will not cause a trend towards listing.

Olive-sided Flycatcher
Since this species prefers open forest or forest edges, upland habitat value may be improved. Created openings will produce greater edge, and if reserve trees and snags are retained, flycatcher habitat could be improved. Therefore, this project may affect olive-sided flycatcher habitat for the better.

Spotted Frog
Riparian habitats along all lakes, rivers, and streams will be managed according to the Riparian and Lake Standards and Guidelines in the TLMP RSDEIS (1996a). With implementation of these measures, no affect on the spotted frog is anticipated by the Upper Carroll Project, even if it was found to occur within the Project Area.

Bull Trout
Due to the distribution patterns of this species, it is not expected to occur in the Upper Carroll Project area. Riparian habitats along all lakes and streams will be managed according to the Stream and Lake Protection management prescription. With the implementation of these measures, no effect on the bull trout is anticipated, even if it was found to occur within the Project Area.

Alexander Archipelago Wolf
Implementing any of the Upper Carroll Project action alternatives will result in a reduction in deer habitat capability. Wolf habitat capability is predicted to be reduced in proportion to the reduction in deer habitat capability. The wolf habitat capability reduction is predicted to range from 1.8 percent for Alternative 7 to 7.3 percent for Alternative 2.

Road density will also increase in the Project Area as a result of implementation of one of the action alternatives. Total road density would range from 1.16 mi./sq. mi. after implementation of Alternative 2, to .2 mi./sq. mi. after implementation of Alternative 1. However, the effect of increased road density would be substantially mitigated by access management and the fact that roads in the Project Area are not connected to any human population centers. Only the mainline road will remain open after project completion. All other roads will be closed by bridge or culvert removal, organic encroachment, or other closure methods. This would result in an open road density ranging from 0.01 to 0.45 as listed below.

Alternative	Open Road Density
1	0.01
2	0.45
3	0.11
5	0.25
6	0.14
7	0.05

All alternatives except Alternative 2 will result in less than 0.4 miles of open road per square mile in the Upper Carroll Project Area. The open road density for the Project Area will be below the critical threshold of 0.93 miles per square mile (Mech et al. 1988) for all alternatives. None of the roads will be connected to the Ketchikan road system.

Because of the reduction in deer habitat capability and the increase in road density associated with implementation of one of the action alternatives, the Upper Carroll Project may affect the Alexander Archipelago wolf. However, the effects of this project are expected to be less for Alternatives 3, 6, and 7 which do not involve extensive roading into previously unroaded areas.

Goose Grass Sedge *(Carex lenticularis var. dolia)*

No observations of this species were made during field reconnaissance of harvest units and roads. This species is not known to occur in forested areas; therefore, no effects are anticipated from timber harvest.

Sensitive Species

Trumpeter Swan

Most timber harvest activity will not be in conflict with the Draft Revision (1991a) Standards and Guidelines for trumpeter swans, since swans are not present in the Project Area when most of the timber harvest activity occurs. There is a potential for conflict when swans are migrating through or returning to wintering areas on Carroll Creek estuary and Neets Bay. Noise from road construction, timber harvest, and hauling of logs could frighten swans away from their preferred resting and feeding areas. However, limiting timber harvest operations to periods when swans are not present (April 1 through November 1) will mitigate these potential impacts for the units that are within a half mile of the Carroll Creek estuary and Neets Bay. (See Mitigation Measures, Chapter 2). The following units are located within 0.5 miles of these areas:

1	13	14	17	24
27	28	29	30	35
37	38	40	41	43
47	48	90	104	106
107	110	133		

Peale's Peregrine Falcon

The nest distribution of this subspecies is closely associated with large seabird colonies, and seabirds are believed to be the major prey of the falcon. The Upper Carroll Project is not near any of the known nest sites of the Peale's peregrine falcon or large seabird colonies and no effect is anticipated.

Osprey

The Upper Carroll Project is not expected to affect nesting osprey because no known nest site occurs in the Project Area, and availability of nesting and foraging areas do not appear to be a factor limiting population growth. In addition, minimal or no effect on osprey habitat is expected from project activities, because uncut buffers will be maintained near streams, lakes, and coastal areas. If nests are discovered in the Project Area, standards and guidelines outlined in the Forest Plan will be followed.

Edible Thistle *(Cirsium edule)*

No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since timber harvest activities generally avoid wet meadows and stream margins where this species would be expected to be found, no direct effects from timber harvest are anticipated even if the species were to occur in the Project Area.

Davy Mannagrass *(Glyceria leptostachya)*
One probable observation of this species was made during field reconnaissance in the vicinity of FEIS Harvest Unit 21. The population was located in a small muskeg below FEIS Harvest Unit 22. No impacts to this population as a result of road construction and timber harvest are anticipated because stream and lakeshore buffers should provide adequate protection for this plant. Any undiscovered populations may be affected by the project. The effects would be to individual plants and would not likely adversely affect population viability.

Wright Filmy Fern *(Hymenophyllum wrightii)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since Wright filmy fern is not known to occur in the Project Area, no effects are anticipated from Upper Carroll timber harvest activities. However, potentially undetected specimens could be affected by the removal of trees from damp woods of the Project Area. Therefore, the Upper Carroll Project may affect individuals, but is not likely to affect population viability.

Truncate Quillwort *(Isoetes truncata)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Furthermore, due to its rooted aquatic nature, this species does not occur in forested areas; therefore, no direct effects from the Upper Carroll Project are anticipated. Even if the species does exist in the Project Area, stream and lakeshore buffers should provide adequate protection for this plant.

Calder Lovage *(Liqusticum calderi)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since Calder lovage is not known to occur in the Project Area, and since its habitat is at a higher elevation than project activities, no effects are anticipated from Upper Carroll timber harvest activities.

Choris Bog Orchid *(Platanthera chorisana)*
Botanical surveys thus far have located six populations of this species within the Project Area. This species has also been found in a number of other locations on Revillagigedo Island during 1995. With the increasing number of observations, it is possible that this species is not as rare as previously thought. Three populations of Choris bog orchid were found in the vicinity of FEIS Harvest Unit 20, two of the three populations are protected as a result of implementing stream buffers. The third population is located in a muskeg scheduled to be crossed by the access road to Unit 20. The road can be located to avoid the small population of Choris bog orchid. Another population was located below FEIS Harvest Unit 22. This population will not be affected since it is outside of the unit boundary and wood will be yarded uphill to the landing and access road. A population was also found in the planned road location to FEIS Harvest Unit 59. This road location will be reviewed to determine the feasibility of relocating the road. This population of Choris bog would likely be destroyed if a feasible route around it is not found. The risk of impacts to the above populations are the same for Alternatives 2-6 since all of these units are in Alternatives 2-6. Unit 59 is not included in Alternative 7, so the risk would be slightly lower for that alternative. One other population of Choris bog orchid was found at the edge of a small pond up the Carroll Creek drainage. None of the alternatives will affect this population.

It is also possible that timber harvest and road construction activities may inadvertently destroy some individual plants. Still, many individuals exist outside road and unit locations. Therefore, the project may affect individuals, but is not likely to adversely affect population viability.

Bog Orchid *(Platanthera gracilis)*
No observations of this species were made during field reconnaissance of harvest units and roads. This species is not known to occur in forested areas; therefore, there are no effects anticipated from timber harvest or road construction activities.

Loose-flowered Bluegrass *(Poa laxiflora)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since loose-flowered bluegrass is not known to occur in the Project Area, no effects are anticipated from Upper Carroll timber harvest activities. However, potentially undetected specimens could be affected by the removal of timber from harvest units encompassing open lowland woods and open-forested meadows.

Straight-beak Buttercup *(Ranunculus orthorhynchus)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since straight-beak buttercup is not known to occur in the Project Area, no effects are anticipated from Upper Carroll timber harvest activities. Even if this species does occur in the Project Area, direct effects due to removal of timber from Upper Carroll harvest units are not anticipated to be significant as preferred open, moist habitats are generally avoided for timber harvest.

Queen Charlotte Butterweed *(Senecio moresbiensis)*
No observations of this species were made during field reconnaissance and no sightings have been documented in the Project Area. Since Queen Charlotte butterweed is not known to occur in the Project Area, no effects are anticipated from Upper Carroll timber harvest activities. Even if this species does occur in the Project Area, direct effects due to removal of timber from Upper Carroll harvest units are not anticipated to be significant as preferred open, moist habitats are generally avoided for timber harvest.

Swan-Tyee Power Transmission Line

It is not anticipated that the Swan Lake-Lake Tyee Powerline Intertie Project will significantly increase cumulative effects above those that have already been analyzed for the Upper Carroll Project. The reason for this is that the proposed road location from Carroll Inlet to Neets Bay is the same as the proposed powerline location.

According to the Draft Environmental Impact Statement, neither of the Alternatives in the Swan Lake/Lake Tyee Intertie Project is expected to have a significant effect on threatened, endangered, or sensitive plant, fish, or wildlife species. Potential effects of habitat fragmentation on species such as the marbled murrelet and Queen Charlotte goshawk would be greatest under Alternative 2, the proposed route, but would not be significant.

It is possible that the transmission line will be an aerial hazard for some bird species, including trumpeter swans, that may migrate through the Project Area. Bird flight deviators will be installed to minimize the risks of collision.

The construction of a road from Carroll Inlet to Shrimp Bay would increase vulnerability of wildlife in the Upper Carroll project through increased hunter access. Road densities would be below recommended levels for wolves, bear, and marten. Road densities would increase from an average of 0.2 miles per square mile to 0.31 miles per square mile for all alternatives and options that include the road. The Upper Carroll Project is not expected to add to this mileage since only the mainline road will remain open after completion of the project. This would be the same road evaluated for the Intertie Project. Neither of the projects include a road connection to Ketchikan. Road use is expected to be minimal.

The Draft EIS for the Swan Lake/Lake Tyee Intertie contains an analysis for impacts of the project on wildlife species.

Forest Health

Key Terms

Endemic—peculiar to a particular locality; indigenous.
Epidemic—rapid spread or sudden prevalence of a disease.
Phloem—the tissue in plants that conducts foods such as sugar.
Xylem—the tissue in plants that conducts water and substances in solution.
Sapwood—the softer part of wood, between the inner bark and the heartwood.

Affected Environment

Forest insects and diseases are normal components of the forested sites in the Upper Carroll Project Area. Some of them exist, and will continue to exist, at endemic levels. Even at low levels of infestation or infection, forest insects and diseases have considerable effects on forest dynamics and resource management values. When they proliferate and become epidemic, the consequences to the forest can be dramatic. Currently there is no indication that insects or diseases are a potential problem in the Upper Carroll Project Area.

Insects

The two most common types of destructive insects found in the Upper Carroll Project Area are defoliators and bark beetles.

Forest Defoliators

Forest defoliators eat the leaves or needles of forest trees. Unlike bark beetles, defoliators usually do not kill trees, but slow down tree growth and increase susceptibility to secondary attack by other insects and diseases. All species of trees are not equally susceptible to injury from defoliation. Hardwood species can usually withstand several years of defoliation because they store large food supplies and can refoliate in the same year. Conifers, on the other hand, may be killed by a single defoliation if it occurs prior to bud formation in midsummer.

The two most common forest defoliating insects that occur within the Project Area at endemic levels include the following:

Black-headed Budworm

Black-headed budworm, *Acleris gloverana* (Wals) is one of the most destructive forest insects in coastal Southeast Alaska. In the 1950s, almost one-third of the net timber volume was lost on some hemlock sites due to budworm defoliation. Larvae usually confine their feeding to new growth. In large concentrations, the larger larvae will feed on older needles. Budworm defoliation can result in growth reduction, top-kill, and, at times, tree mortality. Budworm populations are characterized by sporadic spectacular increases followed two to three years later by equally rapid declines.

Hemlock Sawfly

Hemlock sawfly, *Neodiprion tsugae* (Middleton) is a serious defoliator of western hemlock throughout Southeast Alaska. Outbreaks tend to be more severe and of longer duration in the area south of Frederick Sound, especially along Clarence Strait. Larvae feed on mature foliage rather than the current year's foliage. Most sawfly outbreaks do not cause tree mortality, but some trees are top-killed and radial growth may be reduced. Tree mortality becomes more likely when sawfly and black-headed budworm populations coincide. This is due to the feeding habits of the two defoliators; the budworm feeds on the current year's foliage, whereas sawflies consume previous year's foliage. Natural controls usually reduce epidemic sawfly populations within a few years. Wetter than normal summers help reduce sawfly populations by favoring conditions for fungal growth. Fungi readily infect and kill sawfly larvae under warm, damp conditions. Low summer temperatures can also delay sawfly development and reduce the opportunities for successful egg laying. Eventually starvation and poor nutrition brought about by depletion of the host foliage will also contribute to the population collapse.

Bark Beetles

Bark beetles are probably the most destructive forest insect in Alaska. Bark beetles prefer to breed in weakened host material. However, during favorable climatic periods for beetle development, populations may build up rapidly and healthy trees are successfully attacked. Bark beetles girdle the phloem which, in turn, disrupts the downward movement of nutrients. Some bark beetles, notably those of the genus *Dendroctonus*, have a symbiotic relationship with blue-stain fungi. The blue-stain fungi can completely penetrate the sapwood within a year. The fungi plug up the outer conducting tissues in the xylem which halts upward water movement. This action, plus that of the bark beetles, can cause the death of a host tree.

Spruce Beetle

Spruce Beetle, *Dendroctonus rufipennis* (Kirby) outbreaks have been noted across the Tongass National Forest and adjacent lands in previous years. The spruce beetle life cycle is 2 years, with adult beetles emerging in late May to early June in search of susceptible host material (spruce logs). Dispersing adults can fly for long distances, over 7 miles nonstop. Adult mortality during dispersal is quite high. Female beetles are attracted to windthrow and other downed material. Beetles prefer to attack the sides and bottoms of downed material because of favorable temperature and moisture regimes for brood development. Males are attracted to the site via airborne chemicals produced by the female beetles.

Most outbreaks originate in blowdown or logging residuals (cull logs) and spread to adjacent standing timber. Mortality in unmanaged Sitka spruce stands varies and can be as high as 75 percent.

Diseases

Some of the more common diseases and other forms of damage are discussed below.

Hemlock Dwarf Mistletoe

Hemlock Dwarf Mistletoe, *Arceuthobium tsugense* (Rosendhal, G. N. Jones) is a destructive disease of western hemlock throughout the Project Area. Infestation levels vary in old-growth hemlock stands. Dwarf-mistletoe is absent in some stands and in other stands almost every hemlock is infected. The volume of western hemlock trees heavily infected with dwarf-mistletoe can be reduced as much as 50 percent over a 100-year period. Dwarf-mistletoe is species specific and rarely infects Sitka spruce and mountain hemlock.

The spread of dwarf-mistletoe in young hemlock stands is often the result of leaving standing infected hemlock in cutover areas (TLMP RSDEIS, 1996a). Dwarf-mistletoe responds to light with increased seed production. Rates of spread to adjacent and lower canopy trees will increase in partial cuts where infected hemlocks remain.

Other

Alaska Yellowcedar Decline

Alaska Yellowcedar Decline, which leads to reduced growth and eventual death of Alaska yellowcedar, is a widespread problem throughout the Project Area. This decline is associated with wet, poorly drained sites, and recent research has demonstrated that the primary cause of decline cannot be attributed to any contagious organism (TLMP Draft Revision 1991a). Since it is not contagious, Alaska yellowcedar decline will not spread to sites where it is not found now (TLMP Draft Revision 1991a, pp. 3-117). Because Alaska yellowcedar has high timber value, this annual mortality represents a significant loss in timber value. In addition, substantial acres of old-growth cedar forests have been harvested and are regenerating to other species. The regeneration of Alaska yellowcedar needs to be specifically considered where it forms a significant component of a site proposed for harvest.

Hemlock Fluting

Hemlock Fluting results in deeply incised grooves and ridges that extend vertically along the trunk of the tree. This condition reduces the value of hemlock logs because they yield less sawlog volume and because some of the milled wood contains bark. The cause of hemlock fluting is not completely known but is believed to be genetically controlled. Some sites are heavily affected, to the point of making the stand unsaleable, while other sites have relatively light or no damage.

Decays

Decays that affect the stem and root systems are probably the major cause of volume loss within the Project Area. Many decay fungi enter through tree wounds. The accidental wounding of trees during partial cuts and commercial thinnings will increase the impact from decay organisms in managed stands.

Trees are susceptible to a sequence of diseases at different stages of their growth. Early susceptibility thins a forest stand resulting in more vigorous crop trees. In turn, late susceptibility removes the older and more decadent trees, making room and preparing the way for new trees.

Effects of the Alternatives

Specific pests will be affected differently by each of the alternatives. In general, increasing timber harvest will decrease the impacts of the spruce beetle and timber volume loss by pests such as wood decay fungi and hemlock dwarf mistletoe. From the perspective of timber management, the health of the forest is increased through timber harvesting. However, many of these pests also contribute significantly to ecosystem diversity and long-term stability in old-growth stands by providing increased canopy diversity and animal habitat, and by causing the formation of small scale gaps.

In general, endemic levels of insect and disease activity in mature and overmature forests will be allowed to run their course. Tree losses will be accepted. Salvage logging that exceeds the intent of "minor changes" as defined under the timber sale contract and/or direct control measures will require additional NEPA analysis prior to implementation. The action alternatives all have the same relative environmental consequences from a pest management standpoint regardless of whether viewed from a timber production or a biodiversity perspective.

The previous statement is true as long as the range of silvicultural systems applied remains constant across all alternatives. Partial cuts that retain overstory trees can result in western hemlock (the most tolerant species) forming a much larger percentage of the future stand composition. Sitka spruce, western redcedar, and Alaska yellowcedar occurrence in these sites would be greatly reduced. Partial cutting would increase dwarf-mistletoe infection. Unless a large investment were made to sanitize the stand (remove infected trees) periodically, the future value of the site for timber production could be reduced or even eliminated from an economic standpoint.

Silviculture and Timber

Key Terms

Commercial forest land (CFL)—land that is capable of producing continuous crops of timber (20 cubic feet of tree growth annually, or at least 8 MBF).
Desired future condition or goal—a concise statement that describes a desired future condition normally expressed in broad, general terms that are timeless, in that there is no specific date by which the goal is to be achieved (36 CFR 219.3).
Duff layer—vegetative material covering the mineral soils in forests including the fresh litter and well-decomposed organic material and humus.
Even-aged—management techniques that result in the creation of stands in which trees of essentially the same age grow together.
Managed stand—a stand of trees in which stocking level control is applied to achieve maximum growth.
MBF—thousand board feet.
Logging System Transportation Analysis Plan (LSTA)—interdisciplinary design and mapping of all potential timber harvest units, including associated logging and transportation systems, within a Project Area.
Mid-market analysis—the value and product mix represented at the quarter in which the pond log value (end-product selling price less manufacturing cost) for the species and product mix most closely matches the point between the ranked quarters of the Alaska Index Operation pond log value, adjusted to Common Year Dollars, where one half of the harvest of timber from the Tongass National Forest has been removed at higher values and one half of the timber has been removed at lower values, during the period from 1979 to the current quarter (FSH 2409.22 R10 Chapter 531.1-2).
MMBF—million board feet.
Partial cut—method of harvesting trees where any number of live trees are left standing in any of various spatial patterns; not clearcutting.
Reserved—lands that have been withdrawn from the timber base by an Act of Congress, the Secretary of Agriculture, or the Chief of the Forest Service.
Uneven-aged—management techniques that results in the creation of stands that exhibit a range of diameter or age classes.
Windfirm trees—trees that have been exposed to the wind throughout their life and have developed a strong root system or trees that are protected from the wind by terrain features.
Windthrow—the act of trees being uprooted by the wind. Three types of windthrow include: endemic, where individual trees are blown over; catastrophic, where a major windstorm can destroy hundreds of acres; and management related, where the clearing of trees in an area make the adjacent standing trees vulnerable to windthrow.

Silviculture: Affected Environment

Introduction

Ecosystem Management is a new term that emphasizes an old concept, which incorporates management by objectives with due consideration for biological, physical, and ecological factors. The salient points are two-fold: (1) management of the forest resources must consider a full range of resource objectives, not only commodity outputs; and (2) management must be practical and achievable. The second objective, the physical and biological limitations, serves to restrict the range of treatments and objectives that can be achieved on a particular site. Choices are based on matching the attributes of the silvicultural systems with specific management objectives and the ecological characteristics for specific stands.

Silviculture can be defined as the theory and practice of manipulating forest vegetation; that is, controlling the establishment, composition, and growth to meet various resource objectives in a manner that is biologically, ecologically, and environmentally sound; cost effective; and socially and politically acceptable. Management objectives may include aesthetics, water quality, fisheries, timber, wildlife, or recreation. Wood production may or may not be a primary objective of silvicultural systems.

Silvicultural systems are used to manage forest stands. A stand is a forest community possessing sufficient uniformity in composition, age, spatial arrangement or condition, to be distinguishable and capable of being mapped from adjacent communities. A silvicultural system is a program of treatments throughout the life of the stand; it is the process by which the stand is grown for a specific purpose and it is the means of reaching a desired future condition. This process includes the harvest or regeneration of the stand, intermediate cuttings, and other cultural treatments necessary for the replacement and development of the forest stand. No single silvicultural system can produce all desired combinations of products and amenities from a particular stand or project area. Silvicultural systems are applied through prescriptions, which are written records of the examination, diagnosis, and treatment regimes prescribed for the stand. Prescriptions are prepared and written by a certified silviculturist.

Plant Series

The natural vegetation of the Upper Carroll Project Area is a mosaic of coniferous forest interspersed with alpine tundra, muskeg (bog), shrubland, estuarine, and beach fringe plant communities. The Project Area has been classified into forested plant associations using the Tongass Forest Plant Association Management Guide (USDA 1992), which are based upon the climax plant community. The climax plant community is the result of the interaction between landform, climate, and soils. All forested plant associations having the same climax tree(s) are referred to as a series and are named based upon the climax tree(s). The Upper Carroll Project Area has seven plant series. Forested plant communities, displayed by VCU in Table Silviculture-1, are described below.

Forested Plant Communities

Sitka Spruce Series

Plant associations in this series are generally associated with riparian areas and disturbed sites such as stringers between avalanche chutes. This series can also occur in combination with mountain hemlock at higher elevations. Sitka spruce is the dominant overstory tree species but western hemlock can be a co-dominant. Red alder may also be present. Common shrub species include devil's club, blueberry, and salmonberry. Ferns and skunk cabbage are the dominant herbs. The Sitka spruce series is generally highly productive, and the heights of mature spruce often exceed 150 feet.

Western Hemlock Series

This series has comprised the majority of sites harvested to date on the Project Area. Plant associations in this series generally occur in the uplands on mountain-, hill-, and foot-slopes with moderate to well-drained soils. The predominate overstory tree species is the western hemlock, but Sitka spruce occurs in the overstory in relation to the frequency of disturbance. The shrub layer is dominated by blueberry and rusty menziesia; devil's club, however, can be a major component in some areas. Bunchberry and five-leaf bramble dominate the herb layer, but skunk cabbage can be a major component in areas with poorly drained soils. Plant productivity is generally high, with mature hemlock often exceeding heights of 125 feet.

Most sites harvested to date on the Project Area have been of the Western Hemlock Series.

Mountain Hemlock Series

These plant associations are generally found on cold high-elevation sites above the western hemlock series. Mountain hemlock is the dominant overstory tree species, with Sitka spruce and yellowcedar occurring to a lesser degree. The shrub layer is dominated by blueberry. As the treeless alpine zone is approached, copperbrush and cassiope become more common. Deer cabbage is a common herb. Plant productivity is limited by the shorter growing season at high elevations and by reduced soil drainage common to some of the associations.

Mixed Conifer Series

Mixed conifer associations designate sites with limited productivity due to poor soil drainage or shallow soil, or both. These plant associations generally occur in the uplands, often near muskegs. Dominant overstory tree species are mountain hemlock, western hemlock, western redcedar, and yellowcedar. Sitka spruce and shore pine can also occur. Blueberry and rusty menziesia are the dominant shrub species. Dominant herbs vary and include skunk cabbage, five-leaf bramble, deer cabbage, and ferns.

Western Hemlock-Yellowcedar Series

This series can be considered a subset of the western hemlock series on the Ketchikan Administrative Area. It is most common on mountains and hillslopes around 1,000 feet elevation, but can be found from sea level to the subalpine zone. Dominant overstory tree species are western hemlock and yellowcedar; western redcedar may also be present. Blueberry is the dominant shrub, with rusty menziesia common. Dominant herbs vary and include ferns, bunchberry, dogwood, skunk cabbage, and five-leaf bramble. Site productivity is best described as moderate.

Western Hemlock-Western Redcedar Series

This series represents a transition from the less productive, poorly drained mixed conifer series, to the more productive, better drained western hemlock series. It occurs on a wide variety of landforms, but is most characteristic of rolling hill country, and lower hill- and mountain-slopes. Near the northern limit of its range, redcedar growth is limited by light and temperature. Consequently, while it may be found up to 1,000 feet above sea level, it is most common below 500 feet.

The overstory is dominated by western hemlock. Redcedar commonly occupies 10 to 25 percent of the forest canopy. Yellowcedar may also occur. Other species are incidental. The understory is characterized by blueberry, although salal may be locally common on warmer sites below 500 feet elevation. Site productivity is typically low to moderate on rolling hills and moderate to high on hill and mountain-slopes.

Shore Pine Series

This group of associations is on the transition line from mixed conifer to nonforest muskeg. Soils are poorly drained and productivity is very low. Understory vegetation, because of the abundant light available, is very diverse. Muskeg plants such as Labrador tea, crowberry, bog kalmia, bog blueberry, and sedges are common. Salal may occur on some sites.

Table Silviculture-1 displays the approximate percent of area occupied by each plant series found in the Upper Carroll Project Area.

Table Silviculture-1
Percent of Forested Plant Communities (by VCU and Percent)

VCU	Sitka Spruce	Western Hemlock	Mountain Hemlock	Shore Pine & Mixed Conifer	Western Hemlock-Alaska Cedar	Western Hemlock-Western Redcedar	Total Forested Land
737	1	38	4	6	5	16	70
744	4	17	17	13	2	14	67
746	2	9	13	17	0	36	77

SOURCE: Nightingale 1995

Note: This information derived from Ketchikan Area GIS, CLU data layer.

Nonforested Plant Communities

Various nonforest plant communities occur in estuaries, riparian areas, muskegs, alpine meadows, and alpine lichen rock outcrops in the Upper Carroll Project Area. Nonforested plant communities, displayed by VCU in Table Silviculture-2, are described below.

Estuary Tidal Flats

Estuary tidal flats are inundated by high tides. Vegetation consists primarily of sedges, red fescue, and sea milkwort. Bluejoint and sedges dominate on low terraces, which are rarely inundated by tides, but have high water tables. This also includes unvegetated mud flats.

Shrub Riparian Areas

Shrub riparian areas are found on highly active floodplains and are frequently disturbed. Soils are generally deep and well drained, but flood frequently. Salmonberry, stinkcurrant, devil's club, and ferns are the dominant vegetation.

Muskegs

Muskegs are most often characterized by stunted yellowcedar and shore pine, along with sedges and other bog vegetation. Muskegs dominated by sphagnum moss or tall sedge cover smaller areas. The water table is at the surface, and numerous small ponds are scattered throughout the muskeg.

Alpine Meadows

Alpine meadows are dominated by cassiope and mixed forbs including mountain heather. These meadows are found on steep, well-drained rock outcrops at high elevation. Alpine lichen rock outcrops are found at high elevations above timberline. Plant cover does not exceed 50 percent. Species diversity is high and includes cassiope, clubmoss, and grass species.

Table Silviculture-2 displays the approximate percent of area occupied by each nonforest plant series found in the Upper Carroll Project Area.

Table Silviculture-2
Distribution of Nonforest Plant Communities (By VCU and Percent)

VCU	Estuary Tidal Flats	Shrub Riparian	Muskeg	Rock Outcrop & Alpine Meadows	Water	Total Nonforest Land	Total Forested Land
737	0	7	4	17	2	**30**	**70**
744	*	6	6	20	1	**33**	**67**
746	*	0	1	22	*	**23**	**77**

SOURCE: Nightingale 1995

Note: This information derived from Ketchikan Area GIS, CLU data layer
* = less than 1 percent

Silvicultural Systems

Silvicultural systems are named for the method of regeneration cutting by which the stand is replaced. These regeneration cuttings are selection (single tree and group), seed tree, shelterwood, and clearcut. They can be grouped into even-aged and uneven-aged systems, depending on the type of age structure that is created. Even-aged systems produce stands that consist of trees of the same or nearly the same age. A stand is considered even-aged if the range in tree ages normally does not exceed 20 percent of the rotation age—the age at which the stand is harvested. Seed tree cutting, shelterwood cutting, and clearcutting will produce even-aged stands. Even-aged stands have a beginning and an end point in time. Uneven-aged systems create stands that include three or more distinctly different age classes, with no beginning or end point in time.

Even-aged Systems

Even-aged systems produce distinct successional stages and there are even-aged stands of various ages and sizes distributed throughout the managed forest. Therefore, even-aged forests have relatively low vertical diversity, but have a high degree of horizontal diversity —the forest is a mosaic of forest and openings. The low vertical diversity is a result of the comparatively simple structure of the even-aged stand.

Clearcutting Method

This method involves the removal of the entire stand in one cutting, and reproduction is obtained artificially or by natural seeding from adjacent stands. In the narrowest sense, the cutting operation includes all standing woody vegetation. A variant of this method includes felling only merchantable trees, and with careful harvest technique, retaining the existing advance regeneration. This method is similar to large-scale disturbances such as wildfire or windstorms. The primary objective of this method is to reestablish an even-aged stand by removing the mature one. Decisions to clearcut are usually based on a number of factors such as insect epidemics, disease, fire, decadent stand conditions, desire to change species, desire to introduce genetically superior trees, or desire to meet the needs for regulating volume production through area control.

The clearcutting method with natural regeneration is the most commonly used system on the Tongass National Forest. The system works well, but natural regeneration is usually too abundant. The reproduction is derived partly from wind-dispersed seed and partly from advance reproduction that survived the logging operation.

Silvicultural advantages of the clearcutting method can be listed as follows: (1) it permits longer cable yarding distances than would be practical in partial cutting, permitting wider road spacing, reduced road costs, and less soil disturbance caused by road construction; (2) exposure to the sun raises soil temperatures, which speeds decomposition of the organic forest floor, thereby improving the productivity of the forest site; (3) favors regeneration of Sitka spruce by destroying advance hemlock regeneration (reduces competitive advantage of the hemlock) and disturbing the forest floor, creating seed beds that are more favorable for post-logging reproduction of spruce; (4) eliminates residual overstory trees infected with dwarf mistletoe (preventing infection of western hemlock in the new stand); (5) eliminates the risk of blowdown in residual stands; (6) no logging damage to adjacent standing timber; and (7) logging costs are lower than with other systems.

Silvicultural disadvantages of clearcutting are: (1) seedling distribution is uneven and parts of an area may become understocked or overstocked; (2) species control is poor; (3) the chance of blowdown along cutting boundaries is increased, but can be reduced through proper design of cutting units; (4) it tends to reduce protection against erosion, landslides, and rapid runoff of water; (5) is esthetically the least desirable method, because of the heavily altered appearance of recently harvested areas; and (6) unmerchantable trees may have to be cut.

Currently, the Project Area contains 112 acres of seedlings and saplings. Seedlings and saplings are trees less than or equal to 4.9 inches in diameter at breast height (DBH). There are 3,596 acres of pole timber and young sawtimber (5 inches to 9 inches DBH) sized stands. All of these sites were previously harvested using the clearcut silvicultural method.

Seed-tree Method

This method involves the removal of an old stand in one harvest entry, except for a small number of trees left singly, in small groups, or narrow strips, as a source of seed for natural regeneration. This method mimics a large-scale disturbance such as severe windthrow, which leaves a few mature trees per acre to serve as a seed source.

Silvicultural advantages of the seed-tree method are: (1) better distribution of seed occurs as compared with clearcutting; (2) better species composition than with clearcutting; (3) it can regenerate extensive areas of timber in areas too large to be seeded naturally from adjacent stands; (4) logging costs are low; (5) slightly better aesthetics than clearcutting; and (6) seed trees add some vertical diversity.

Silvicultural disadvantages of the seed-tree method are: (1) it is limited to windfirm trees and it is not feasible where seed-trees will be blown over by wind; (2) control of spacing and the timing of the new crop is difficult; (3) it is costly to harvest seed trees, and damage occurs to regeneration; (4) soil protection is not much different than clearcutting; (5) it is commonly limited to light weight-seeded species; and (6) it is inappropriate when the seed-trees have infestations of hemlock dwarf mistletoe (parasitic plant).

Shelterwood Method

This method involves the establishment of a new stand under the canopy of the old stand. Shelterwood cuttings mimic large-scale natural disturbances in which many trees are lost and the residual large trees may provide seed, and shelter the natural regeneration from extreme heat and cold. Hemlock and spruce lend themselves to shelterwood cutting because both species can become established under a forest canopy.

Silvicultural advantages of the shelterwood method are: (1) it allows ultimate control of site conditions for the regeneration of even-aged stands; (2) natural regeneration is usually more certain than the seed-tree or clearcut method because there is a more abundant source of seed; (3) good soil protection is provided; (4) it is superior to all methods, except selection, with respect to protection of site and aesthetic considerations; (5) it can be applied to large areas; (6) it provides the best control over species composition, amount, and distribution; and (7) sheltering trees add some vertical diversity.

Silvicultural disadvantages of the shelterwood method are: (1) logging costs are increased because of the returns to the same area for smaller volumes and the care exercised to prevent excessive damage; (2) it requires a fairly windfirm species and it is not feasible where the sheltering trees will be blown over, hemlock and spruce rarely exhibit windfirm characteristics; (3) unavoidable damage to residual stand and reproduction occurs during logging, particularly on cable ground; (4) it is inappropriate when the sheltering trees have infestations of dwarf mistletoe; (5) several Oregon studies in hemlock-spruce stands suggest that overstocking of regeneration can be expected; (6) it is difficult to maintain spruce in the understory, because hemlock can tolerate more shade than spruce; and (7) growth rate of seedlings is slower under shade.

Uneven-aged Systems

Uneven-aged systems produce stands of high structural diversity because of the intermingling of the different age classes. Regulation of the forest is based on development and maintenance of a range of tree diameters, with many trees in the smaller diameter classes and progressively fewer in the larger diameter classes. These forests have a high degree of vertical diversity, but horizontal diversity will be low. The system produces large blocks of continuous forest cover dominated by relatively mature trees; there is a gradual reduction of shade intolerant trees and understory plants. This system has not been formally tested in the hemlock-spruce type of Southeast Alaska.

Regulation of even-aged management is based on the area and time required to grow trees to a merchantable size. Regulation of uneven-aged stands requires the establishment of: (1) maximum tree diameter, (2) residual stocking levels or volume required to maintain growth and yield, and (3) the desired structure which controls the diameter distribution.

Single-tree Method

Trees are removed individually at random, from a large area. This method simulates natural disturbances caused by the death of scattered trees. Regeneration occurs under the partial shade of larger trees, and seedlings must be able to grow in a shaded environment. Sitka spruce and western hemlock are adapted to grow in a shaded environment. Under the selection method, the stand always has some relatively old trees. Some of the cuttings may be intermediate in immature age classes. Each tree is evaluated for its contribution to the desired characteristics of the stand.

Silvicultural advantages of the single tree selection are: (1) it is capable of maintaining an uneven-aged stand; (2) reproduction of tolerant species is easily obtained; (3) seedbed site protection is excellent with little or no exposure to insolation (exposure to sunlight) and wind; (4) stands can be readily adapted to changing market conditions; and (5) it usually has the highest aesthetic rating.

Silvicultural disadvantages of the single-tree selection method are: (1) highly skilled people are needed to practice it; (2) logging costs are much higher because of the small volume per acre, the frequent entries to each stand required, the complexity of the logging systems, and the care necessary to hold damage to an acceptable limit; (3) crop trees are scattered throughout the stand; (4) risk of wind damage within the stand increases with partial cutting; (5) a more extensive road system needs to be constructed and maintained to secure the same volume of timber as obtained by use of other systems; (6) it would not be suitable for hemlock stands infected with dwarf mistletoe; (7) frequent light entries can result in accelerated stand deterioration as the stand is opened up to wind, and damage can be done to boles and roots of residual trees from felling and yarding tall, large-diameter, defective trees; and (8) shade tolerant western hemlock would eventually replace spruce and cedar species within the stand.

Group Selection Method

Trees are harvested in small groups (usually less than two acres). The openings created in the stand resemble miniature clearcuts and the uneven-aged stand is composed of a mosaic of even-aged groups; the small openings simulate small natural disturbances.

Silvicultural advantages of the group selection method are: (1) the regeneration in the small groups grows up under even-aged conditions and better stem form is obtained; (2) harvesting is more concentrated so logging costs are lower than single-tree; (3) harvesting in groups lowers damage to the residual stand; (4) it tends to increase diversity of plants and animals because of a temporary increase in shade intolerant plants in the small openings; (5) intermediate cuts may be made less frequently without sacrificing diameter class distribution although composition may be affected; (6) the small groups may be esthetically more acceptable to some people; and (7) the small openings would be more favorable for spruce and cedar regeneration.

Silvicultural disadvantages of the group selection method are the same as the single-tree method but to a lesser degree. The major limitations on its use are the operational difficulties in the steep, rugged topography found in the Project Area.

Criteria for the Selection of Harvest Cutting Method

Criteria for the selection of harvest cutting methods to be used on national forests in Alaska are provided in 36 CFR 219.27(b) and the Alaska Regional Guide (USFS November 1983). The selected method must meet all of the criteria, which are:

1. Capable of meeting special management and multiple-use objectives (36 CFR: Criteria 1 and 6, Regional Guide: Standard 2);

2. Permit control of vegetation to establish desired species composition, density, and rates of growth (36 CFR: Criteria 4 and 6);

3. Promote a stand structure and species composition which minimizes risks from solar radiation, disease, and windthrow (36 CFR: Criterion 4, Regional Guide: Standard 2);

4. Use available and acceptable logging methods (36 CFR: Criterion 4, Regional Guide: Standard 2);

5. Assure that lands can be adequately restocked (36 CFR: Criterion 2);

6. Be practical and economical in terms of transportation, harvesting, preparation, and administration of timber sales (36 CFR: Criterion 7, Regional Guide: Standard 2); and

7. Not be selected solely on the basis of greatest dollar return or highest output of timber, and not permanently reduce site productivity or impair conservation of water and soil resources (36 CFR: Criteria 3 and 5).

In addition to the applicable laws and regulations, on June 4, 1992, the Chief of the Forest Service issued national direction on reduced use of clearcutting (Robertson 1992). Clearcutting would be limited to areas where it is essential to meet forest plan objectives and involve one or more of the following circumstances:

1. To establish, enhance, or maintain habitat for threatened, endangered, or sensitive species;

2. To enhance wildlife habitat or water yield values, or to provide for recreation, scenic vistas, utility lines, road corridors, facility sites, reservoirs, or similar developments;

3. To rehabilitate lands adversely impacted by events such as fires, windstorms, or insect or disease infestations;

4. To preclude or minimize the occurrence of potentially adverse impacts or insect or disease infestations, windthrow, logging damage, or other factors affecting forest health;

5. To provide for the establishment and growth of desired trees or vegetative species that are shade intolerant;

6. To rehabilitate poorly stocked stands due to past management practices or natural events;

7. To meet research needs.

Factors Influencing the Choice of Silvicultural Systems

The choice of silvicultural systems will depend on the silvical characteristics—that is, the reproductive habits and growth requirements—of the tree species, the operational environment (physical and biological setting), the management objectives that are to be achieved, and the operational feasibility of all logging systems (e.g., highlead, skyline, tractor, helicopter, etc.).

Silvical Characteristics - Commercial Species

Sitka Spruce

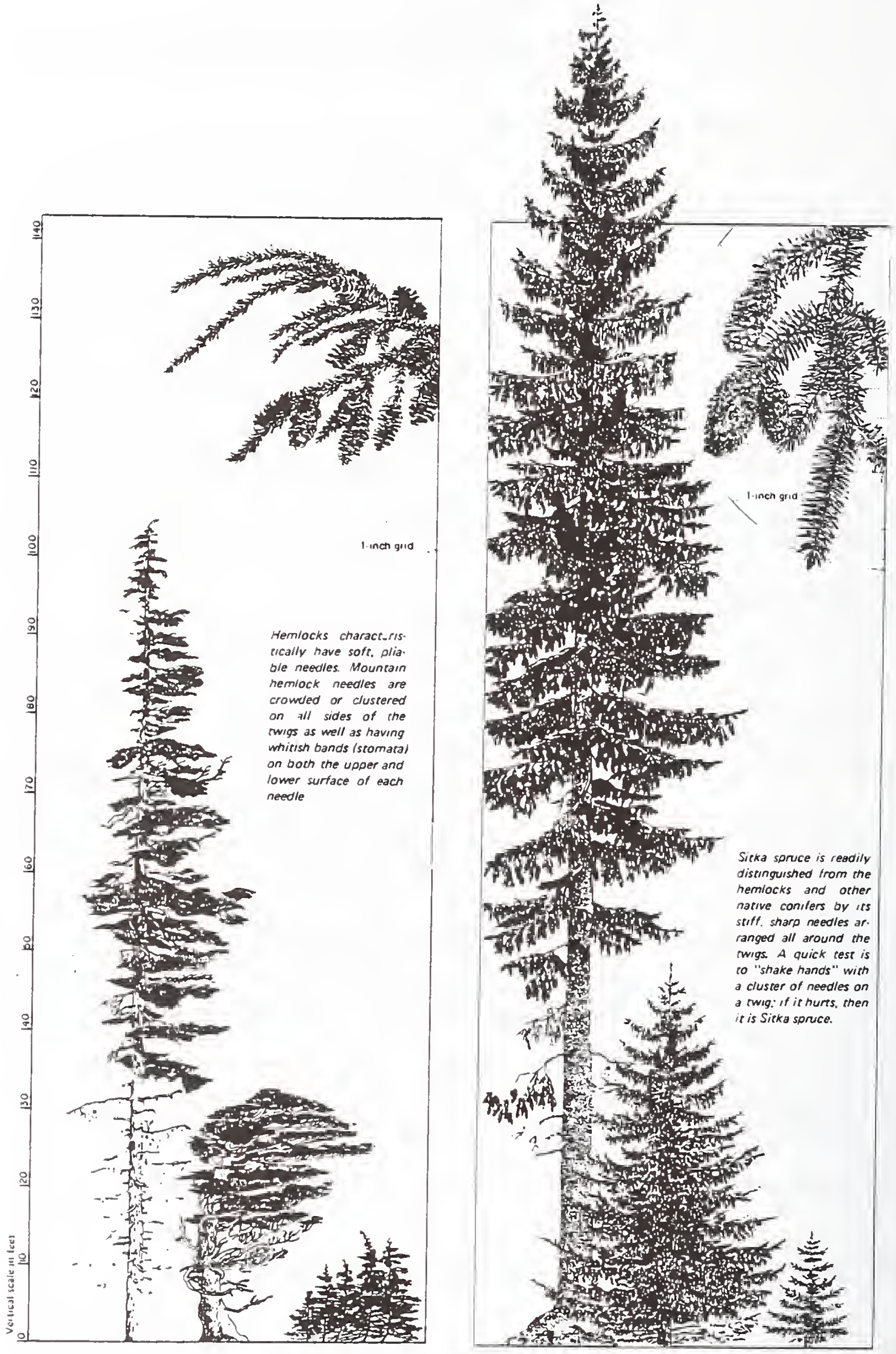
Sitka Spruce (*Picea sitchensis*) is the largest and one of the most valuable trees—both biologically and economically. This species is classified as intermediate in tolerance ("tolerance" is defined as the ability to grow and prosper in the understory; light, moisture, or other environmental variables may be the limiting factor) and demands more light than its associate western hemlock (Harris and Farr 1974). Sitka spruce is a prolific seed producer. It produces small seed that can be carried long distances. Sitka spruce seed will germinate on almost any kind of seedbed if moisture is abundant. Natural regeneration can, consequently, be obtained through various reproduction methods. Establishment is best on mineral soil with organic matter and with side shade and overhead light. Spruce has an advantage over hemlock on bare soil. The percentage of spruce reproduction often can be increased by clearcutting and exposing more mineral soil during the logging operation (Fowells 1965). The rooting characteristics of Sitka spruce show great variability, but in Southeast Alaska, the species tends to be shallow rooted. Consequently, the species is vulnerable to compaction and blowdown. The bark is relatively thin which makes it susceptible to logging injury and subsequent decay. Blowdown is the most serious damaging agent to Sitka spruce.

Western Hemlock

Western Hemlock (*Tsuga heterophylla* (Raf.) Sarg.) is also a major component of the Tongass National Forest. Western hemlock is classified as very tolerant and dominates the reproduction of the old-growth forests (Fowell 1965), which makes it an ideal species for management that includes partial cutting. Other associated conifers include western redcedar, Alaska yellowcedar, shore pine, lodgepole pine, Pacific silver fir, subalpine fir, and mountain hemlock. Western hemlock is a prolific seed producer. It produces seed almost every year, with heavy crops every 5 to 8 years; the seed is small and can be carried long distances in strong winds. The species can thrive on a wide variety of seedbeds; consequently, natural reproduction can be obtained through various reproduction methods from single tree to clearcutting. Most stands contain advanced regeneration and through careful logging are often adequately stocked or overstocked. Hemlock does not develop a taproot and is a shallow-rooted species, thus is susceptible to windthrow. Most of the roots, particularly the fine roots, are near the surface and are susceptible to damage from compaction. Like spruce, this species also has thin bark and is susceptible to logging injury and subsequent decay. Hemlock dwarf mistletoe is a common disease and is usually best controlled by clearcutting.

Figure Silviculture-1 illustrates characteristics of the mountain hemlock and Sitka spruce.

Figure Silviculture-1
Characteristics of the Mountain Hemlock and Sitka Spruce



MOUNTAIN HEMLOCK *Tsuga mertensiana*

SITKA SPRUCE *Picea sitchensis*

Western Redcedar

Western Redcedar (*Thuja plicata Donn*) is an important tree species both economically and from a cultural perspective as well. Southeast Alaska Natives use this species for totem poles, clan houses, canoes, etc., because of its straight grain, size, light weight, and workable texture. The stringy bark was used for making mats, baskets, and ropes. Western redcedar is commonly found in association with Alaska yellowcedar, western hemlock, lodgepole pine, and Sitka spruce.

Western redcedar is less tolerant than western hemlock and Sitka spruce. Western redcedar is a prodigious seed producer, but because of the small surface area of the seed wing, the seed does not travel far from the source. Although the germination percentage is often quite good, the seedling mortality rates are usually quite high, particularly when exposed to full light. Western redcedar is near the northern edge of its range in the Project Area and is typically found on poorly drained organic soils in combination with Alaska yellowcedar, lodgepole pine, western hemlock, and Sitka spruce. The best growth is achieved on better sites, where it forms a minor component of the stand with hemlock and spruce dominating. The best regeneration occurs on sites that have exposed mineral soil and full light. Like most cedars, the tree is long lived and highly resistant to insect and disease attacks. The shallow water table on most organic soils makes western redcedar susceptible to windthrow. It is considered less windfirm than either spruce or hemlock and is used only as a last resort for either tailholds or guyline anchors.

Alaska Yellowcedar

Alaska Yellowcedar (*Chamaecyparis nootkatensis* (D. Don, Spach)) is a minor, but valuable, commercial tree species found within the Project Area. At lower elevations it is commonly found on poorly drained organic soils in association with western redcedar, western hemlock, lodgepole pine, and Sitka spruce. At elevations above 1,000 to 1,500 feet western redcedar is no longer a stand component and mountain hemlock replaces western hemlock. At elevations above 1,200 to 1,500 feet Alaska yellowcedar may only be of firewood quality. Good cone crops are irregular, occurring only one out of every four to seven years. The seed is heavy and will disperse 132 to 264 feet (two to four chains). Alaska yellowcedar is classified as an intolerant species like western redcedar, and as such, it is less shade tolerant than hemlock or spruce. Alaska yellowcedar is especially susceptible to winter drying where warm, sunny weather, in combination with frozen soils, causes top kill. Warm weather in the winter of 1956, resulted in extensive top kill that is still evident today. Yellowcedar decline is another problem (possibly the same as winter drying) that is resulting in dead tops and mortality. The upper third of the crown is the most productive for cone production and seed viability. The harvesting of old-growth cedar forests through large clearcuts has resulted in regeneration to other species. Whether this is due to the periodicity of the seed crops, the heavy seed with limited dispersal distance, cedar decline, or some other cause is not known. Artificial regeneration or some form of partial cutting may be needed to ensure the continued presence of yellowcedar. Alaska yellowcedar is not particularly windfirm, but trees with dead tops provide much less resistance to the wind and may therefore be quite windfirm.

Figure Silviculture-2
Characteristics of the Western Redcedar and Alaska Yellowcedar

Silvical Characteristics - Noncommercial Species

Pacific Yew

Pacific yew (*Taxus brevifolia nutt.*) is a small tree or shrub that has never been found as far north as the Project Area, but scattered trees have been located on the southern portion of Revilla Island (T. Demeo, USDA FS, Ketchikan Area Ecologist, personal communication 1992). Pacific yew is at the very northernmost portion of its range. It is typically found within 500 feet of saltwater as it depends upon the warm maritime climate to exist at this latitude. The bark from Pacific yew is high in taxol, which has been shown to have medicinal value for the treatment of cancer. The bark from Pacific yew trees located across the country is currently being tested for its taxol content. Cancer treatments are currently using taxol on an experimental basis. Due to the scattered nature of Pacific yew trees, it is envisioned that plantations will be developed from the seeds of trees that have the highest taxol content in order for the medicine to be affordable. Pharmaceutical companies are currently attempting to develop a synthetic version of taxol.

Alder

Alder (*Alnus species*), both red and Sitka alder, are found throughout the Project Area. Sitka alder tends to be shrublike in form, with multiple stems, and rarely exceeds 30 feet in height. In contrast, red alder usually has a single, well-defined stem and can reach heights of up to 50 feet in the Project Area. Alder is commonly found along beaches and streams, and on avalanche tracks and landslide chutes. Alders are also common on roadsides, landings, and wherever soil has been highly disturbed. Alder is a primary succession species (one of the first to recolonize highly disturbed sites) and is usually shaded out 40 to 50 years after first being overtopped by Sitka spruce. Red alder is rarely found above 1,000 feet in elevation, but Sitka alder may grow above 2,500 feet in the Project Area. Alder seed is extremely light and can be spread great distances by the wind. A mineral soil seedbed is required and both species of alder are extremely shade intolerant. During its maximum growing period, alder can achieve 5 feet of height per year. Both species have the ability to fix nitrogen from the air. Because of this ability to fix nitrogen, and from abundant leaf fall which adds needed humus, alder is important for stabilizing or improving disturbed forest soils. Red alder is used for smoking fish and for carving, but neither species is used commercially.

Operational Environment

Climate

The forest has a maritime climate with abundant moisture throughout the year and has relatively mild winter temperatures and cool summers. Lack of a pronounced drought is probably the most important factor in affecting vegetation. The combination of warm water from the Japanese currents and prevailing westerly onshore winds result in cool, humid conditions throughout the Project Area. The weather patterns of Southeast Alaska develop strong wind patterns and winter storms tend to be very intense. Gale force winds may occur during any month, however, the strongest winds are most likely to occur in fall and winter months. The strong winds are usually accompanied by rainfall, and saturated soils that contribute to blowdown.

Table Silviculture-3 displays the number of days, by month, when gale force winds occurred between 1953 and 1978.

Table Silviculture-3
Number of days, by month, with winds over 30 miles per hour, National Oceanographic and Atmospheric Administration (NOAA) meteorological station at Annette Island, Alaska, 1953-78

	Miles per Hour						
Month	**31-35**	**36-40**	**41-45**	**46-50**	**51-55**	**56-60**	**Total Days**
July	3						**3**
August	5	4					**9**
September	11	7	3		1		**22**
October	67	45	13	4	3		**132**
November	58	41	5	8	1		**113**
December	64	39	9	9	2	3	**126**
January	70	29	5	6	2	2	**114**
February	60	31	2	8			**101**
March	25	9	8	4			**46**
April	32	9	7	2			**50**
May	8	5	2				**15**
June	11	1	1				**13**
Total	**414**	**220**	**55**	**41**	**9**	**5**	**744**

SOURCE: Wind in the Forests of Southeast Alaska and Guides for Reducing Damage, A. S. Harris, PNW-GTR-244.

Over 80 percent of the gale-force winds reported between the years 1953 and 1978 were from the south or southeast. Gale force winds occur during every month of the year and come from all directions. However, the vast majority of gale-force winds come out of the southeast and occur during the fall and winter months when heavy rains have saturated the soils.

The management implications are: (1) moisture is not a limiting factor in tree regeneration; (2) wildfire is not a major problem; (3) high winds can cause heavy losses of timber by windthrow; (4) the relative risk of windthrow determines the range of silvicultural options available to meet the management objectives for a given site; and (5) the strong fall winds favor natural regeneration.

The rooting habits of western hemlock and Sitka spruce make these species susceptible to windthrow; both species are shallow rooted and depend on mutual support for wind resistance. Western hemlock does not develop a tap root. In addition, both species have thin bark, which makes them susceptible to logging damage to the tree bole and subsequent wood decay. Trees with stem or root rots are more susceptible to damage from the wind. Wind is a major disturbance factor in Southeast Alaska, altering the structure of the forest. Scattered windthrow of large overmature trees is a prime cause of mortality and it creates small openings in which the advance growth in the understory may develop (group selection would mimic this effect). Spruce is able to maintain itself as a stand component because of these small openings created by windthrow. Stands covering many acres can also be blown down and many existing young-growth stands originated following the blowdown of the previous stand. The traits of windfirm stands and stands susceptible to damage by wind are documented in Table Silviculture-4.

Table Silviculture-4
Traits of Windfirm Stands and Traits of Stands Susceptible to Windthrow

Trait	Windfirm Stands	Susceptible Stands
Age	Young	Old
Age Structure	Even-aged	Uneven-aged
Defect	Little Defect	Large amounts of defect
Height	Short	Tall
Stocking	Open stocking on less productive sites, muskeg or scrub stands	Dense Stocking on Productive Sites
Species Composition	Have a high percentage of cedar and hardwoods	Predominately spruce and hemlock
History	Intact with little evidence of recent openings	Previously damaged by blowdown Even-aged pole or young sawtimber opened by thinning or partial cutting

SOURCE: Wind in the Forests of Southeast Alaska and Guides for Reducing Damage, A. S. Harris, PNW-GTR-244.

Topography

Topographic features also influence the probability of windthrow occurring. The following features may result in decreased windfirmness:

- Westerly or easterly aspects where storm winds are accelerated around ridges;
- Southerly aspects exposed to onshore winds;
- Sideslopes or flats parallel to water channels oriented in a general northwest-southeast direction, especially along the west side of channels—flats and valley bottoms at heads of inlets or bays exposed to southerly winds;
- Small islands, promontories, or slopes at constrictions of channels with open water to windward;
- Low ridges or upper leeward slopes.

Topography also influences the choice of logging methods and silvicultural methods. Historically, most yarding has been downhill because roads are usually located in valley bottoms to avoid the unstable soils on the steep slopes. Cable logging downhill in partial cuts is especially difficult because of inadequate deflection for full suspension and lack of large enough tree root systems for adequate tailholds. Spruce and hemlock are prone to logging damage because of their thin bark and the risk of damage to residual trees is extremely high when attempting to remove trees, particularly on steep slopes using cable logging methods. Stands typically consist of large old trees with significant defect. These stands require large yarders to remove the logs. To control residual stand damage the logging plan must incorporate and the logger must conduct operations recognizing the following: (1) eliminate cross-slope yarding where dragging of logs is involved; (2) during lateral yarding, the skyline must be positioned so that the entire log turn will be suspended above the ground when the logs enter the skyline corridor; (3) yard with the skyline positioned high above the ground to reduce skyline corridor width (lateral excursion); (4) log turns must fly free of the ground in downhill yarding; and (5) skyline setting size must be restricted to control the clearcut effect from fan-shaped settings. The inability to meet all of these conditions on most areas generally makes cable logging partial cuts impractical. Other, more costly options, such as helicopters, would have to be used.

Rationale for Selection of Harvest Cutting Methods

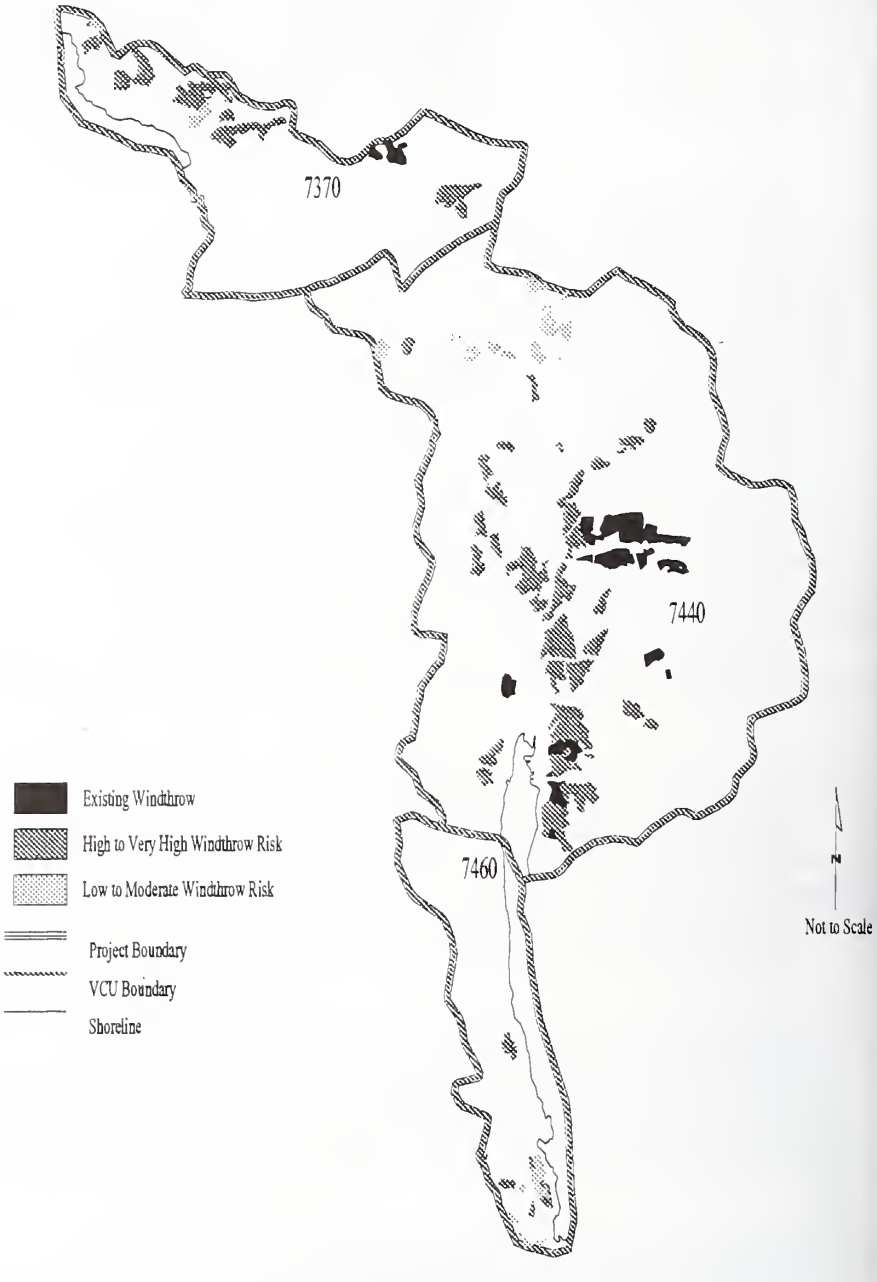
Both even-aged and uneven-aged harvest cutting methods are available for selection within the suitable productive forest lands. Factors other than the silvicultural or ecological limitations of the species weigh heavily in the choice between uneven- and even-aged management and among the several silvicultural systems that can be used to create even-age stands. These include: economic considerations, other resource values, terrain considerations with its limitations on logging systems, and other operational environmental considerations such as the presence or absence of dwarf mistletoe, susceptibility to windthrow, and susceptibility to logging damage.

The first step in the selection of an appropriate silvicultural system for an individual site is the diagnosis or range of acceptable treatments including a deferred (no action, Alternative 1) entry. An acceptable treatment is one that is feasible and has a reasonable expectation of achieving sound silvicultural objectives. Silvicultural objectives typically include species composition, stand condition class, growth rate, density, insect and disease control, and stand development over time.

The next step is to use the Forest Plan, management concerns, and public issues to determine the objectives for the site, then select the silvicultural system that best meets the objectives. In order to meet the issues and concerns reflected in the various alternatives, one or more silvicultural systems may be selected for the same site, depending upon the alternative.

In Southeast Alaska, the range in silvicultural options is limited by numerous factors, but the most dominant is the risk of windthrow. Areas of high windthrow risk offer the option to defer entry or to clearcut. Other forms of regeneration harvest have little or no probability of success where long-term timber production is at least one of the objectives for the site. The one exception to the above statement is where cedar forms a significant component of the stand structure. Because of the extensive top kill caused by cedar decline, the tops of these trees pose little resistance to the wind and are, therefore, relatively windfirm. This is especially true at higher elevations where the soils are frozen rather than saturated during the winter months when the majority of gale-force winds occur (see Table Silviculture-3). Figure Silviculture-3 displays the areas of high windthrow risk.

Figure Silviculture-3
Windthrow Risk Areas



The most dominant factor affecting silvicultural options is the risk of windthrow.

Areas of moderate-to-low windthrow risk have a full range of silvicultural options available. Clearcutting is generally selected for these areas for the following reasons:

1. It is the most effective means of controlling dwarf mistletoe. The removal of infected trees interrupts the life cycle of dwarf mistletoe and reduces the chance for infestation of the future stand. (36 CFR: Criterion 4, Regional Guide: Standard 2, Chief's Policy Letter: Criterion 4)

2. It eliminates the risk of blowdown in residual stands. The potential for windthrow increases along cutting boundaries but can be reduced through proper design of cutting units. (36 CFR: Criterion 4, Regional Guide: Standard 2, Chief's Policy Letter: Criterion 4)

3. It eliminates the risk of stand damage to the residual stand. The spruce-hemlock stands are composed of large trees and require large pieces of logging equipment which can cause significant damage to the residual stand. Spruce and hemlock tend to be shallow rooted, and therefore, susceptible to damage from ground based systems; clearcutting reduces these risks. (36 CFR: Criterion 4, Regional Guide: Standard 2, Chief's Policy Letter: Criterion 4)

4. It favors spruce and cedar. The logging operation will destroy some of the advance hemlock regeneration and thus take away its initial advantage. The increased sunlight also favors the spruce. (36CFR: Criteria 4 and 6, Chief's Policy Letter: Criterion 5)

ling and yarding large trees often nages the remaining stand.

5. It can improve productivity. The cold air temperature and soil temperature do not favor decomposition of the organic forest floor. Exposing the site by clearcutting raises temperatures, which speeds the decomposition of raw humus and recycling of nutrients, particularly nitrogen. (36 CFR: Criterion 5, Chief's Policy Letter: Criterion 5)

6. It requires less road development. Less road construction is needed to remove a given amount of timber. Clearcuts favor longer spans which also allows for increased spacing between roads. (36 CFR: Criterion 5)

7. It is less costly. Fixed costs are spread over large volumes per acre and logging and road building is more concentrated. (36 CFR: Criterion 3 and 5, Regional Guide: Standard 2)

8. Natural regeneration is generally adequate. Experience with clearcutting since the 1950s, has shown that, except for certain situations, attaining natural regeneration is not a serious problem in the Upper Carroll Project Area. Natural regeneration is abundant and generally averages 3,000 to 5,000 stems per acre 10 years after harvest. Competition among seedlings for growing space and nutrients results in reduced growth rates at about age 15 to 20. Stocking control is intended to increase the rate of diameter growth of the remaining trees; tree size has a significant impact on log values, improves crown ratios, favors commercially valuable trees (spruce), favors species (forage) or age classes which are most valuable for wildlife, windfirmness may be increased with early thinnings, or achieve other multiple-use objectives. (36 CFR: Criterion 2, Chiefs Policy Letter: Criterion 4 & 5)

Those LUDs that contain selection or group selection harvest systems are lands that will be managed primarily for maintenance and enhancement of resource values other than timber. Generally, any management of the timber resource on these lands will be for stand maintenance purposes only and will approach an uneven-aged silvicultural system. Production of high current or future timber yields is not a consideration. This prescription is primarily applied within stream riparian area boundaries.

Stand maintenance is not, strictly, a silvicultural system. Under this management regime or concept, individual trees or small groups of trees are removed if conditions indicate a disease or pest threat to the stand, imminent mortality, severe decline in growth, or trees in cable corridors. Stand maintenance, while a form of uneven-aged management, is different than the selection system (group or individual-tree) of management. Selection implies strict stocking control and a high intensity of management to maintain a predetermined ratio of tree ages and diameter classes in every stand. The intent is to manage the timber stands on these lands in order to maintain or bring them to the best condition possible until actual selection silviculture becomes feasible on these lands, until even-aged management can be made environmentally acceptable, or the lands are classified as unsuitable.

In addition to stand maintenance prescriptions, the other form of partial cutting that is being proposed in the Upper Carroll project is called a shelterwood harvest. Technically this is referred to as the seed cut in a two-step shelterwood. The purpose of the seed cut is to provide seed and shelter to promote a new crop of trees. The seed cut is followed (usually 10 to 20 years later) by an overstory removal that removes the trees left as seed and shelter during the first entry. The purpose of this prescription is to respond to an issue raised during public scoping and an internal concern that following clearcutting, natural regeneration of yellowcedar is generally lacking. Alaska yellowcedar forms a significant portion of the following plant associations:

Western hemlock-yellowcedar- all associations
Mixed conifer- all associations
Mountain hemlock-yellowcedar- all associations.

The yellowcedar sites will regenerate naturally if clearcut, but the species composition is primarily western hemlock, mountain hemlock, Sitka spruce or western redcedar, depending upon the elevation. Yellowcedar will usually not be represented and must be planted to re-establish the species. Sites that are clearcut harvested using a helicopter will require a helicopter to move people and planting stock to and from the unit. Helicopter costs to support planting activities can vary significantly depending upon the number of acres available to spread fixed costs over. Costs typically range from $700 to $1,200 per acre. The quality or grade of yellowcedar declines with increasing elevation. At lower elevations, sawlog quality cedar is of the highest value, while at higher elevations, yellowcedar is primarily utility grade. Helicopter logging of utility grade yellowcedar followed by expensive artificial regeneration efforts make it more expensive to retain the yellowcedar on high elevation, helicopter logging sites.

Table Silviculture-5 displays the approximate acreage of identified partial removal opportunities for this project by VCU and alternative. The only form of partial cutting being attempted is called a shelterwood harvest in which the trees below a specified diameter will be retained on the site to provide seed and shelter for a future crop of trees. Alternative 1, the no-action alternative, proposes no harvest activities and is not displayed. Refer to Appendix H, Silvicultural Diagnosis and Appendix K, Unit Design Cards, for a specific description of the silvicultural system recommended for each harvest unit.

Table Silviculture-5
Acreage of Partial Tree (Shelterwood) Removal Opportunities Identified for the Upper Carroll Project by VCU and Alternative

	Alternative					
VCU	**1**	**2**	**3**	**5**	**6**	**7**
737	0	96	0	96	0	0
744	0	237	15	157	100	37
746	0	0	0	0	0	0
Total	**0**	**332**	**15**	**252**	**100**	**37**

SOURCE: Nightingale 1996

Note: This information derived from Ketchikan Area GIS, Upper Carroll Silviculture Coverage.

Silvicultural systems other than clearcutting have not been applied on a large-scale basis in Southeast Alaska. The anticipated results are based primarily on research and experience from other parts of the country. Because of the experimental nature of these proposed harvest systems, each unit is considered to be a clearcut for the purposes of analyzing the direct effects on the visual and wildlife resources.

Reserve Tree Harvest Strategy (Two-aged system)

Clearcutting with reserves maintains a portion of an existing stand (individual trees, clumps, and groups) creating a two-layered structure with two or more age classes. This stand management system would be incorporated where site-specific conditions permit, under which 10-20 percent of the trees in each timber harvest unit would be left uncut to improve the habitat quality of second-growth stands in the future (TLMP RSDEIS, 1996; letter dated April 5, 1996; FS-6200-28b 3/92).

The rationale behind using this system is to:

- Provide biological and structural diversity in stands by leaving standing green trees individually or in groups.
- Reduce the impacts to scenic resources.
- Provide better protection of landslide prone sites by retaining a living root system.

Reserve Tree Selection Criteria

During the planning process, acreage within the CFL classification is identified as non-suitable for timber harvest. These areas are often high value habitat or riparian areas, Class I and II stream buffers, MMI 4 soils, wildlife corridors, estuary and beach buffers, eagle nest buffers, etc. These areas are usually located adjacent to identified harvest units and are considered a large part of the reserve tree strategy. If site specific conditions permit, additional reserve tree acreage is identified within harvest units during the layout phase of the project.

In a two-aged system, live reserve trees are retained indefinitely in groups (within or adjacent to harvest units) or as individually scattered trees throughout harvest units. If site specific conditions permit, the following guidelines for selection of reserve areas within a conventional cable harvest unit would be used during the layout phase of the project:

- Blind lead areas, rock outcrops, small unstable areas, or small wetland areas of concern could be utilized for reserve tree islands.
- Additional reserve tree clumps at unit boundaries could be designated where logging feasibility allows.
- Identified stream buffers could be utilized within a unit. These buffers may also be increased in width if additional reserve tree areas are needed.
- Utilize previously unbuffered streams within unit if needed.
- Design reserve tree islands between roads if no other option is available and additional reserve tree acreage is needed.

In units where shelterwood harvest is prescribed by implementing a diameter limit cut, individual scattered trees would be left. These units would require helicopter yarding which would leave smaller diameter trees (usually Alaska yellowcedar) as a seed source.

During harvest unit layout, minor changes to planned tree reserves may be considered if the majority of the reserve tree area is left intact. Planned or layout reserve tree area selections should not be considered no-cut zones or retention areas. Various reasons for adjusting reserve tree areas may include not isolating otherwise harvestable patches of timber or correcting setting boundaries to facilitate logging feasibility, to name a few.

It should be noted that when trees are prescribed to be left within harvest units, Alaska Department of Labor and Occupational Health and Safety Act (OHSA) regulations become paramount. Forest operatives working around reserve trees are exposed to a higher risk of danger then would otherwise be encounter in a clearcut with no reserve trees. The Region 10 publication *Reserve Tree Selection Guidelines* (R10-MB-215, March 1993) is used in the Upper Carroll planning process for reserve tree strategies as well as in developing guidelines for reserve tree strategies within harvest units. A more thorough discussion of this publication is presented in the Timber Section, Chapter 3, Logging Systems.

Silvicultural Systems

Harvest Types

A harvest type describes a general silvicultural treatment that will be applied to the units in the Project Area. Each Clearcut Type is designed to implement a particular standard silvicultural system. Modifications to the standard systems were applied where necessary to protect resources, provide for reserve tree areas, ensure logging feasibility, and provide timber volume.

Type 1 Clearcut unit boundary implementation would use the following criteria:

- Retain tree islands or fingers behind identified blind leads.
- Leave trees in clumps at unit boundary, where feasible.
- Utilize or expand buffers of Class 1 and 2 streams that flow within and adjacent to the unit.
- Utilize previously unbuffered streams within the unit, if required.
- Increase width of buffered streams within unit, if required.
- Retain tree islands or fingers where there are rock outcrops, slope, or areas of MMI 4 soils or wetlands concern.

Type 2 Clearcut replaces Type 1 clearcuts where helicopter yarding is required. Operator implementation would use the following criteria:

- Follow Silvicultural Prescription for quantity and type of leave trees within unit.
- Retain snags throughout unit as safety conditions allow (see Reserve Tree Selection Guidelines, Timber Section, Chapter 3, Logging Systems).
- Helicopter yarding is required.
- Utilize some Type 1 Clearcut criteria, if required for resource protection.

Size of Harvest Units

The National Forest Management Act of 1976 (NFMA) specifies a limit on the size of forest opening which may be created based on the forest type. For the western hemlock/Sitka spruce forest type associated with Southeast Alaska, this maximum opening size is 100 acres. The NFMA provides leeway for extending this opening size to 150 acres under certain conditions, such as timber economics, regeneration requirements, wildlife or fisheries habitat needs, transportation or harvest system requirements, etc., and for exceeding 200 acres under extreme circumstances such as major insect and disease outbreak, fire, windthrow, or other form of catastrophic damage.

Action Alternatives 2, 3 and 5 propose one or two harvest units which exceed 100 acres. Alternatives 1, 6 and 7 propose no harvest units over 100 acres in size. All harvest units are under 150 acres. Table Silviculture-6 summarizes the number of units proposed by each alternative which exceed 100 acres.

Table Silviculture-6
Number of Units Exceeding 100 Acres and Range of Harvest Unit Size

Alt.	Total No. of Units/Alt.	Number Exceeding 100 Acres	Exceeding NFMA Size Requirements Acres
1	0	0	0
2	72	1*	106
3	40	1*	106
5	60	2	106 and 110
6	42	0	None
7	24	0	None

SOURCE: Nightingale 1996

* Alternatives 2 and 3 also schedule the harvest of FEIS Harvest Unit No. 120, which is 20 acres in size. This unit is adjacent to an existing created opening (Shelter Cove Sale). The resulting opening will be approximately 135 acres for two to three years after harvest until green-up is achieved in the Shelter Cove units. Existing windthrow indicates a need to tie the boundaries together to create a windfirm boundary.

Note: This information derived from Ketchikan Area GIS, Upper Carroll LSTA Layer.

A detailed list of the individual units exceeding 100 acres, along with the reason for their inclusion, is shown in Appendix B.

Proposed Harvest by Site Class

Because some site classes are more productive than others, they are rated by a site index and are assigned a class of low, medium, or high. The site index is based on the expected height to which a tree will grow on that site within a given number of years (in this case 50 years). On low sites, trees would be expected to grow between 45 and 56 feet in height in 50 years. On medium sites, trees would be expected to grow between 57 and 66 feet in height in 50 years. On high sites, trees would be expected to grow more than 77 feet high in 50 years. In general, more timber can be grown at less cost on a high site than on a medium or low site, and more timber can be grown at less cost on a medium site than on a low site (Davis 1966). However, by mixing high, medium, and low sites, average logging costs for low sites can be reduced and more land is available for timber management over the rotation.

Table Silviculture-7 displays the acres of proposed harvest for each alternative by site class.

Table Silviculture-7
Acres of Proposed Harvest by Site Class (Productivity)

	Low		Medium		High		Total	
Alt.	Acres	%	Acres	%	Acres	%	Acres	%
1	0	0	0	0	0	0	**0**	**0**
2	202	10	758	38	1,036	52	**1,996**	**100**
3	80	7	203	19	791	74	**1,074**	**100**
5	93	6	590	36	935	58	**1,618**	**100**
6	57	6	468	45	506	49	**1,032**	**100**
7	88	15	100	17	403	68	**591**	**100**

SOURCE: Nightingale 1996

Note : This information derived from Ketchikan Area GIS, CLU data layer.

Alternative 2 proposes to bring the highest number of acres in medium and high site classes under management (1,794 acres or 90 percent of the acres proposed for harvest). Alternative 5 proposes to bring the second highest number of acres in medium- and high-site classes under management (1,525 acres, or 94 percent of the acres proposed for harvest), followed by Alternative 3 (994 acres or 93 percent of the acres proposed for harvest), Alternative 6 (974 acres or 94 percent of the acres proposed for harvest) and Alternative 7 (503 acres or 85 percent of the acres proposed for harvest). Alternative 1 proposes no timber harvest at this time and therefore does not provide an opportunity to bring medium and high sites under management.

Indirect and Cumulative Effects

Regeneration

All of the areas proposed for timber harvest will be restocked within five years as required under the National Forest Management Act of 1976 (NFMA). A combination of natural regeneration and artificial regeneration (tree planting) will be utilized to restock harvested areas. Prescribed fire for site preparation is not being proposed for any of the Alternatives.

Natural regeneration or planting result in the growth of a new stand of trees.

Harvested sites must contain a minimum of 300 well dispersed trees per acre by the fifth year following harvest to be considered successfully regenerated. Survival (staked tree) surveys will be conducted on all planted sites the first and third full growing seasons after being planted. Regeneration (stocking) surveys must be conducted on all harvest units the third and fifth full growing season after yarding is complete. The third year survey is used to determine whether, if any, additional reforestation efforts are required. The fifth year survey is used primarily to certify that the regeneration process has been successful. Table Silviculture-8 shows the acres of essential reforestation treatments to be performed by alternative. It should be recognized that areas requiring artificial regeneration cannot be accurately identified until after harvest when the third year stocking surveys indicate inadequate natural regeneration. Thus, these acreage figures may change at the time planting would occur.

Table Silviculture-8
Anticipated Essential Reforestation Treatments (by Alternative) in Acres

Alt.	Natural Regeneration Surveys 3 & 5 years	Plantation Stocking Surveys 1 & 3 years	Prescribed Tree Planting
1	0	0	0
2	1,996	305	305
3	1,074	198	198
5	1,618	226	226
6	1,032	198	198
7	591	141	141

SOURCE: Nightingale 1996

Note: This information derived from Ketchikan Area GIS, Upper Carroll Silviculture Coverage.

Long-term Timber Productivity (Yield)

The effects of all action alternatives on long-term yield would be the conversion of unmanaged, overmature stands to managed, faster growing, early seral, even-aged stands. Overmature stands have lower forest floor temperatures than even-aged stands; thus reducing biological activity. Organic decomposition slows, and as a result, the supply of available nutrients is reduced. With decreased biological activity, less nitrogen is available for tree growth and nutritional status is lowered. While overmature stand growth and vigor remain nearly constant, they are at a level below that of even-aged stands (Harris et al. 1974). Table Silviculture-9 displays the average structural characteristics of managed stands by site classification (low, medium, and high).

The magnitude of the effect of converting unmanaged, overmature stands to managed, even-age stands will vary depending upon the number of acres harvested in each site class. Table Silviculture-7 shows that Alternative 2 converts the most acres to managed condition (1,996 acres), followed by Alternative 5 (1,618 acres), Alternative 3 (1,074 acres), Alternative 6 (1,032 acres), and Alternative 7 (591 acres). Alternative 1 proposes no timber harvest and will not convert any stands to a managed condition.

Table Silviculture-9
Average Structural Characteristics of Managed Stands (by Site Classification)

Stand Age (years)	Height (feet)	DBH (inches)*	Volume/Acre (board feet)**
Low Site			
5-20	26	1.4	0
20-50	56	4.9	1,900
50-80	82	8.5	14,100
80-100	96	10.8	25,500
100-120	107	12.8	37,100
120-160	122	16.4	56,800
Medium Site			
5-20	29	3.5	0
20-50	66	9.8	7,400
50-80	98	13.6	29,800
80-100	114	15.7	46,100
100-120	126	17.8	61,400
120-160	144	21.3	81,900
High Site			
5-20	31	4.0	100
20-50	77	11.0	13,900
50-80	111	15.2	43,400
80-100	127	17.5	62,400
100-120	139	20.1	78,000
120-160	157	24.1	100,300

SOURCE: Forest Service 1991

* Diameter at breast height; ** Net Sawlog

All stands proposed for harvest are overmature and well beyond the age of maximum average annual growth of the stand. They are representative of uneven-aged western hemlock stands that commonly take hundreds of years to develop under natural conditions (that is, unless they are changed by natural events such as windthrow or manipulated by intensive forest management practices).

The open conditions created by clearcutting allow both Sitka spruce and western hemlock to regenerate rapidly. Even-aged stands are generally comprised of 10 to 75 percent spruce, depending on the soil type and age of the stand. On average, the volume of spruce in even-aged stands 75 to 100 years after harvest is about 50 percent (Taylor 1934) compared to 28 percent in existing overmature stands. With the use of precommercial thinning, an additional ten percent increase in the spruce component is expected.

Although log quality in second-growth stands is expected to be lower than in existing overmature stands, even on sites that have been precommercially thinned, total yield per acre will be higher in second-growth stands. The lower quality will be reflected in the log grades, with second-growth timber stands having fewer top grade logs than existing overmature stands. In addition, second-growth stands will have less volume in the larger diameter classes. Nevertheless, total yield will be significantly greater in second-growth stands than in over-mature stands. The long-term result of precommercial thinning is more useable wood fiber. Precommercial thinning also allows the option of reducing the economic rotation age. This is because merchantable size logs are produced at an earlier age if the site is thinned.

Most second-growth even-aged stands will exhibit less variation in tree diameter and height than the overmature stands they replace. At 100 years of age, average diameters for unmanaged second-growth stands will range from 13 inches on medium sites to 15 inches on high sites. With precommercial thinning, it is possible to produce average stand diameters that approximate old-growth averages. At age 100, diameters can range from 16 inches on medium sites to more than 18 inches on high sites (Forest Service 1990).

Precommercial Thinning

Regeneration of naturally disturbed or harvested areas may result in stocking levels of seedlings/saplings on many upland sites with an average of 4,000 stems per acre. Although these stands will eventually thin naturally, production of useable wood fiber would be hastened if stocking were less dense through the use of precommercial thinning (Harris and Farr 1974). Growth and yield models indicate that for every acre precommercially thinned, timber yield increases by 6.9 MBF on medium and 8.9 MBF on high sites, over a 100-year rotation. Precommercial thinning reduces the competition for sunlight, moisture, and nutrients for what is often referred to as growing space. This additional growing space results in the understory plants and remaining conifers growing at accelerated rates for longer time periods than unthinned, second-growth stands. Precommercial thinning can also be used to change species composition and windfirmness of the stand. Where necessary, release (felling submerchantable whips infected with dwarf mistletoe) will occur immediately after harvest or on some sites at the same time as the precommercial thinning to prevent the re-infection of the new crop of trees. It should be recognized that precommercial thinning is performed approximately 15-20 years after harvest and is dependent upon site, stocking, and other resource needs. While it would be desirable to precommercially thin many of the medium and high sites, the acres identified reflect historic funding levels and projected future management regimes. Table Silviculture-10 shows the number of acres that have been identified for potential precommercial thinning in the future by alternative.

Precommercial thinning prolongs understory vegetation and enhances growth rates on the remaining trees.

Table Silviculture-10
Precommercial Thinning & Release Acres by Alternative

Alternative	Release	Potential Precommercial Thinning Sites 15-20 Years after Harvesting: Scheduled	Potential
1	0	0	0
2	107	121	1,794
3	7	58	994
5	119	59	1,525
6	96	55	974
7	40	51	503

SOURCE: Nightingale 1996

Note: This information derived from Ketchikan Area GIS, Upper Carroll Silviculture Coverage. Scheduled sites reflect historical funding rates and diagnosis. Potential sites equal medium and high site index lands.

The Silviculture Diagnosis

Appendix H presents a detailed listing of the sites by alternative where precommercial thinning is proposed when the stand reaches 15 to 20 years old.

Second Growth Management for Other Resource Values

Fisheries Rehabilitation

Approximately 3.4 percent of the riparian management areas within the Project Area were harvested between 1954 and 1990. Most of this timber harvest occurred in the Carroll Creek and Neets Creek watersheds 20 to 35 years ago, before any significant stream protection measures were implemented. As a result, many Class I and Class II streams that would receive a stream buffer today, were harvested up to the bank.

Riparian management areas previously harvested for timber are now in various stages of secondary plant succession. Except where the ground was highly disturbed, the stand composition on the secondary successional riparian areas is similar to riparian vegetation prior to timber harvest, with Sitka spruce typically forming the canopy. On the more disturbed sites where mineral soil was exposed during timber harvest activities, the vegetation is often composed of early successional species, such as red alder and salmonberry.

Many studies have established the need for LWD material in streams. It is an important component to bedload dynamics as well as providing structure, habitat, and as nutrient sources. Existing riparian stands of extremely dense conifers or alder, similar to those in Neets Creek, for example, will require a long period of time (150-200 years) to develop large material for recruitment. Management of these existing riparian stands could produce the same size material for recruitment much sooner. On a high site index stand (most riparian sites are very productive), a precommercial thinning at age 15 (maintain growth rates and promote windfirmness), followed by a second precommercial thinning at age 40 to 50 (variable spaced thinning from below and a high thinning that would girdle rather than fell the trees) could produce five to 24 snags per acre over 15 inches in diameter (USDA Technical Bulletin No. 544). This would also promote the initial development of a two-storied stand. A third noncommercial entry at age 75, utilizing a combination of high and low thinning by girdling rather than felling, could create as many as six to ten snags per acre over 24 inches in diameter. The objective of this type of treatment would be to promote a multi-storied canopy layer over time, promote habitat for snag dependent wildlife, and as the snags fall over, begin to provide LWD much sooner than would occur naturally. A site-specific silvicultural prescription that incorporates the concepts listed above could be prepared if funding is available for fisheries rehabilitation work.

Wildlife Management

The structure and composition of second-growth stands are dramatically different than that of old-growth. Second-growth management is not intended to mimic or replace the need for old-growth (see Chapter 3, Biodiversity section). It is possible to achieve commodity production objectives in a way that lessens the negative impacts upon certain wildlife habitat needs through the application of ecosystem management principles. However, in places like Neets Creek, large drainage bottom clearcuts in the 1960s have created expansive second-growth stands. These are dense, single-storied stands with little understory forage and few standing snags. The prevailing theory on second-growth management for wildlife would say that these stands are too old to thin for forage enhancement (over 25 years of age). The IDT concurs with that assessment.

Second-growth stands that were once part of historic wildlife travel corridors or important winter habitat (low elevation, south aspect, productive site) would benefit from precommercial thinning. The key to this strategy is to extend the rotation (example 200 years) and not manage for short-term benefits at the beginning of the rotation, but to emphasize wildlife values over the last 100 years of the extended rotation. For example, a combination of low thinning and girdling could create snag habitat by age 50-60 years; subsequent girdling every 30-40 years would maintain snag habitat as well as allow for recruitment of forbs and shrubs back into the site much sooner than would occur naturally. The extended rotation would assure that these benefits accrue over a longer period of time.

A site-specific silvicultural prescription that incorporates these concepts would be prepared in coordination with a wildlife biologist prior to implementation, should funding be available. Due to the fact that most second-growth management prescriptions to promote other resource values are somewhat experimental (very few examples of managed older second-growth exist), the potential benefits were not used in modeling future wildlife/fisheries or other resource values.

Plant Community Successional Stages Including Old-growth

After reforestation, managed forests grow through several distinctive successional stages which generally are applicable to all units proposed for harvest under the action alternatives. Characteristics such as height, diameter, and productivity vary according to site class (discussed previously in this section). Different components dominate the stand at different stages, and the overall forest structure changes over time.

Managed forests progress through several distinctive successional stages.

Seedling/Sapling Stage

The first 20 years following harvest is referred to as the seedling-sapling understory colonization stage. During the first five years of this stage, the young stand receives maximum sunlight, resulting in the rapid establishment of a variety of shrubs, forbs, and grasses. There is little incidence of damage or mortality from disease or infestation at this stage. The changed structure of the young stand affects the structure of adjacent stands—windthrow potential increases with greater wind exposure and understory development accelerates due to increased sunlight into the newly developing stand.

In years 5 to 20, seedlings grow into a vigorous new forest of trees, averaging about 20 feet in height and 1 to 3 inches diameter at breast height (DBH). Understory production of woody-stemmed species is at its highest at this stage, especially in blueberry dominated sites. Larger dead materials from the original stand begin to decompose, and the stand edge is stabilized, resulting in less windthrow to the adjacent stand. At the end of this successional stage, the stand can be considered for precommercial thinning, leaving a species composition of about 60 percent western hemlock, 40 percent Sitka spruce, and a small cedar component.

Table Silviculture-11 tracks the cumulative acres in the seedling/sapling stage from the present condition, through implementation of each alternative, to the end of the long-term contract in 2004. These figures represent the current condition and the changes that occur over time as the stands grow from one stage to the next. Alternative 2 projects the highest number of acres in the seedling/sapling stage (2,109 acres), followed by Alternative 5 (1,730 acres), Alternative 3 (1,186 acres), Alternative 6 (1,144 acres) and Alternative 7 (703 acres). Alternative 1, the No-Action Alternative, projects the lowest number of acres in this successional stage.

Table Silviculture-11
Direct and Indirect Effects in Acres on the Seedling/Sapling Stage (by VCU and Alternative)

	Alt. 1		Alt. 2		Alt. 3		Alt. 5		Alt. 6		Alt. 7	
VCU	**1997**	**2004**	**1997**	**2004**	**1997**	**2004**	**1997**	**2004**	**1997**	**2004**	**1997**	**2004**
737	3	3	369	369	3	3	204	204	3	3	3	3
744	0	0	1,581	1,581	1,024	1,024	1,397	1,397	1,020	1,020	541	541
746	109	32	159	82	159	82	129	52	121	44	159	82
Total	**112**	**35**	**2,109**	**2,032**	**1,186**	**1,109**	**1,730**	**1,653**	**1,144**	**1,067**	**703**	**626**

SOURCE: Nightingale 1996

Note: This information derived from the Ketchikan Area GIS database, SIS data layer. Alternative 2 harvests the maximum amount of timber, while still meeting Forest Plan Standards & Guidelines. The 2004 values for Alternative 2 represent the projected indirect affects of timber harvesting through the life of the Long-term Sale Contract for all alternatives. The effects of time on the successional stages is important for estimating the effects on wildlife. Therefore, the Alternative 2, 2004 values were not repeated to avoid masking this information.

Future harvest through 2004 will add to the acreage in this stage. Alternative 2, which harvests the maximum amount of timber allowed under Forest Plan Standards and Guidelines, has been used to project the level of harvest through 2004. It is assumed that reduced levels of harvest as part of a current alternative will be harvested in a future entry. To do otherwise, would require a change in the land use allocation, which is beyond the scope of this document.

Pole/Young Sawtimber Stage

The next successional stage occurs during years 20 to 50 following harvest and is referred to as the understory exclusion stage. It is characterized by accelerated tree growth (approximately 1 foot per year) and a rapidly closing tree crown canopy. At age 50, tree heights range from 48 to 72 feet and diameters range from 5 to 10 inches, depending on the site class. Tree crowns begin to grow closer together, causing the understory to change from a dense shrub, herb, and seedling-dominated structure to one of dense moss. Stands which have been precommercially thinned will have a two-layered canopy with western hemlock in the lower story. Canopy closure will occur more slowly in precommercially thinned sites. As any proposed harvest would probably not begin until 1997, and is expected to be completely offered by 1998, none of the units proposed for harvest at this time would grow into this successional stage by 2004. The only change that occurs is the growth of some of the existing harvest units into the understory exclusion stage.

In years 50 to 80, the stand remains closed. At age 80, tree heights range from 74 to 107 feet and diameters range from 8 to 13 inches, depending on site class. Little sunlight reaches the forest floor, and the understory continues to be dominated by moss. Tree diameter growth slows to about 1 inch every 10 years, as competition between trees increases. It is not currently economically feasible to commercially thin trees at this stage, but thinning would increase growth and diversity of the shrub layer, as well as increase diameter growth of the remaining trees.

Table Silviculture-12 tracks the cumulative acres in the pole/young sawtimber stage from the present condition, through implementation of each alternative, to the end of the long-term contract in 2004. These figures represent the current condition and the changes that occur over time as the stands grow from one stage to the next.

Table Silviculture-12
Direct and Indirect Effects in Acres on the Pole/Young Sawtimber Stage by VCU and Alternative

	Existing Condition	Alt.1		All Action Alternatives	
VCU	**(1993)**	**1997**	**2004**	**1997**	**2004**
737	2,417	2,417	2,417	2,417	2,417
744	1,074	1,074	1,074	1,074	1,074
746	105	105	182	105	182
Total	**3,596**	**3,596**	**3,673**	**3,596**	**3,673**

SOURCE: Nightingale 1996

Note: This information derived from the Ketchikan Area GIS database, SIS data layer.

As the proposed harvest would probably not begin until 1997, and is expected to be completely offered by the year 1998, none of the acres proposed for harvest in this entry would grow into this successional stage by 2004. Likewise, none of the projected harvest through 2004 would have grown into this successional stage. The only change that occurs is the growth of some of the existing harvest units into the pole/young sawtimber stage. Thus each alternative shows the same number of acres in this successional stage after implementation and in 2004.

Mature Sawtimber Stage

In years 80 to 100—the mature, even-aged forest and understory reinitiation stage—the stand becomes mature. At age 100, tree heights range from 88 to 123 feet and average stand diameters range from 10 to 15 inches, depending on site class. Some trees may die, while others become clearly dominant in size. Diameter growth remains at less than 1 inch every 10 years. Moss continues to dominate the understory, except in places where the canopy has opened and allowed sufficient light for herbaceous plants. These structural characteristics continue into the later stages of the stand (approximately 100 to 160 years) with continued slow growth and occasional openings in the canopy (Forest Service 1989b).

Old-growth Stage

The final successional stage for a forest is the old-growth stage, which would pertain to stands that are prescribed to be managed for old-growth conditions or stands that have been deferred for harvest. This stage is characterized by a multi-storied stand with a large over mature overstory composed of live and dead trees and an understory of mostly shade-tolerant western hemlock. There would be a substantial component of downed large trees and occasional openings in the forest canopy. Patches of shrubs, tree saplings, and herbs alternate with patches of overmature timber, creating a complex, multi-layered mosaic. The stand declines in growth and has the highest degree of variation and most structurally diverse understory of any successional stage.

Table Silviculture-13 presents the acres of old growth that existed prior to the KPC Long-term Timber Contract, the acres that are projected to remain following implementation of each alternative, and the acres of old growth expected to remain at the end of the contract period (2004).

Table Silviculture-13
Projected Acres of Remaining Old-growth Sawtimber by VCU and Alternative

	Existing Condition	Alt. 1		Alt. 2		Alt. 3		Alt. 5		Alt. 6		Alt. 7	
VCU	(1995)	1997	2004	1997	2004	1997	2004	1997	2004	1997	2004	1997	2004
737	3,706	3,706	3,340	3,340	3,340	3,706	3,340	3,505	3,340	3,706	3,340	3,706	3,340
744	11,464	11,464	9,883	9,883	9,883	10,440	9,883	10,067	9,883	10,444	9,883	10,923	9,883
746	2,471	2,471	2,421	2,421	2,421	2,421	2,421	2,451	2,421	2,459	2,421	2,421	2,421
Total	**17,641**	**17,641**	**15,644**	**15,644**	**15,644**	**16,567**	**15,644**	**16,023**	**15,644**	**16,609**	**15,644**	**17,050**	**15,644**
% of 1954 Acres	81	81	72	72	72	76	72	74	72	77	72	79	72

SOURCE: Nightingale 1996

Note: This information derived from the Ketchikan Area GIS database, TIMTYP data layer.

The cumulative effects of harvesting old-growth will result in the conversion of large areas to a mosaic of second-growth sites of differing age classes. By the year 2140, it is projected that 12,319 acres, or 57 percent of the original 21,706 acres of old-growth (commercial forest land) will remain in the Project Area, if the Preferred Alternative of the TLMP RSDEIS (1996a) is implemented.

At the end of the rotation, approximately 12,319 acres or 57 percent of the old-growth will remain intact.

Timber: Affected Environment

Forest Classification

The 45,232 acres of land within the Upper Carroll Project Area are defined by their ownership and vegetative cover. This land has been categorized as forest land, nonforest land, or other ownership.

Other Ownership

Other ownership refers to lands owned by private individuals, by the State of Alaska, or by Alaska Native corporations. For the purposes of this document, it also includes lands which have been selected, but not conveyed to the State or to Native corporations (see Land Status section of this chapter). About 1.9 percent (approximately 845 acres) of the Project Area is encumbered, or may soon be in other ownership.

Nonforested

Nonforested means National Forest System land that is biologically unable to support a cover of predominantly timbered vegetation. This includes muskeg, rock out-croppings, talus slopes, and water bodies, among others. About 15.3 percent (approximately 6,940 acres) of the Project Area falls into this category.

Forested

Forested land refers to National Forest System land that consists largely of timbered vegetation and is further categorized as commercial forest land or noncommercial forest land. There is about 38,292 acres or 84.7 percent of the Project Area that falls into this category.

Noncommercial Forest Land (non-CFL)

Noncommercial forest land does not support enough timber volume to meet the criteria for CFL. The Project Area forested land area contains about 36.7 percent (16,586 acres) of noncommercial forest land.

Commercial Forest Land (CFL)

Commercial Forest Land (CFL) is capable of producing continuous crops of timber. The Forest Service has specified that each acre of CFL must be capable of producing 20 cubic feet of tree growth annually or must contain at least 8,000 board feet (8 MBF) of net timber volume (USDA Forest Service 1977a). Old-growth and second-growth stands (younger, even-aged stands that grew after the previous stand was harvested or destroyed by agents such as wind, fire, or insects) may qualify as CFL. The Upper Carroll Project Area is composed of about 48 percent (21,706 acres) CFL.

Figure Timber-1 displays the breakdown of the various Forest Land Classifications within the Project Area, Figure Timber-2 identifies the components of the CFL, and Figure Timber-3 identifies CFL and State Land Selections within the Project Area.

Figure Timber-1
Forest Land Classifications

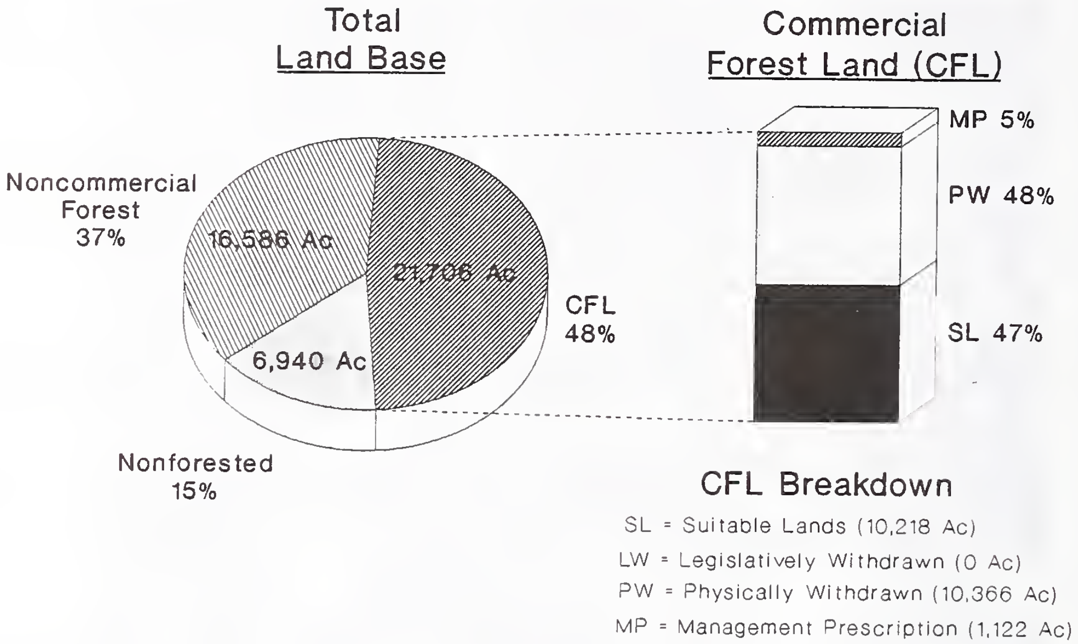
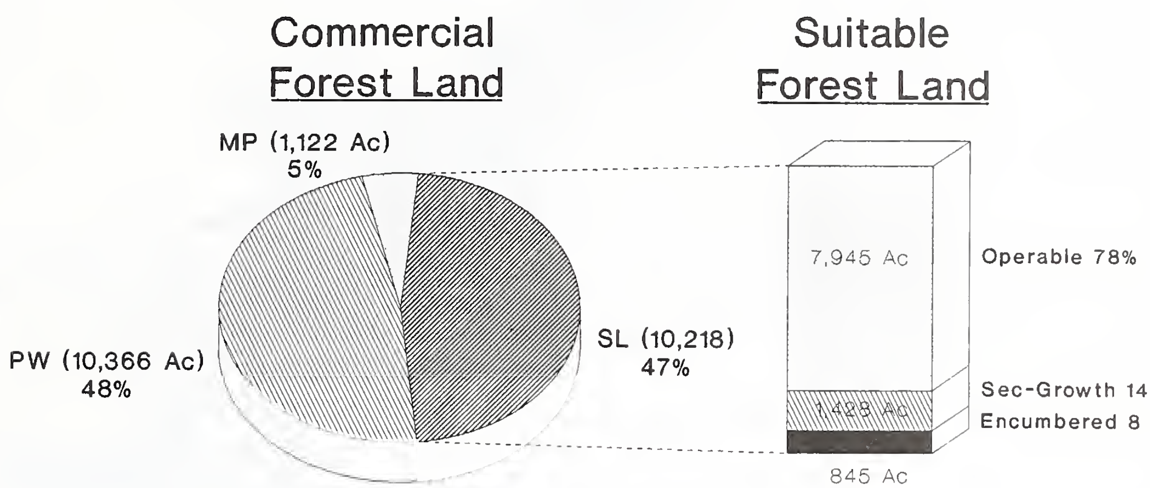


Figure Timber-2
Components of CFL



SL = Suitable Lands
PW = Physically Withdrawn
MP = Management Prescription

Figure Timber-3
CFL Within the Project Area

Tentatively Suitable Forest Lands

CFL is further defined as to its suitability undergoing review as identified in Appendix A of TLMP (1979, as amended), TLMP Revision (1991a). To be considered Tentatively Suitable, the CFL must:

- be forested lands that have both the biological capability and availability to produce crops of industrial wood;
- not be developed for nonforest uses;
- be capable of harvest with available technology to ensure timber production without irreversible resource damage to soil productivity or watershed conditions;
- be capable of restocking within five years after final harvest;
- have adequate information available to project response to timber management practices;
- have not been withdrawn legislatively from a timber production classification.

Suitable Forest Lands

Tentatively Suitable is further refined as Suitable Forest Lands. For the purposes of this analysis, all lands which have a management prescription or proposed management prescription that precludes timber harvest are eliminated from the tentatively suitable base. The remainder are classified as suitable.

To be considered suitable for harvest, these forested lands must have a LUD that allows commercial timber harvest (LUD III or LUD IV).

For this process, Project Area lands have also been deferred from the suitable base if they have a TLMP RSDEIS (1996a) LUD prescription that does not permit commercial timber harvest.

Lands withdrawn from the Tentatively Suitable, not contributing to the suitable base considered for this project, include encumbered lands (see Chapter 1), buffers mandated by the Tongass Timber Reform Act on certain fish-bearing streams, 100-foot buffers around all lakes greater than five acres in size, 500-foot buffers around the saltwater shoreline, 1,000-foot buffers around estuaries, and 330-foot buffers around all known eagle nests. About 52 percent of the Project Area (approximately 23,526 acres) is non-CFL. This leaves approximately 21,706 acres of CFL.

Table Timber-1 displays the type and amount of adjustments made to the CFL, which lead to the suitable base.

Table Timber-1
Adjustments to the CFL, Leading to Suitable Acreage

	VCU			
	737	**744**	**746**	**Totals**
CFL (acres)	6,102	12,745	2,859	**21,706**
Soils	1,100	4,693	1,858	**7,651**
Wilderness	0	0	0	**0**
TTRA/RP Zone	973	1,600	142	**2,715**
Watershed and experimental	0	0	0	**0**
Estuary and beach buffers	397	409	310	**1,116**
Eagle buffers	0	0	6	**6**
No harvest prescription	1,760	451	62	**2,273**
Available suitable (acres)	1,932	5,690	529	**7,945**

SOURCE: GIS, Llanos, Marks 1996

Suitable Base

Previous harvest within the Project Area has largely used clearcut logging methods. Previous timber harvests have occurred within the Project Area for both the long-term and the independent sale program. Previously harvested timber stands (second-growth) were considered unavailable for timber harvest for this project analysis. About 14 percent of the suitable base, or 6.5 percent of the CFL (approximately 1,428 acres) has been previously harvested from the Upper Carroll Project Area excluding encumbered lands.

Volume Class

CFL in the Tongass National Forest has been classified into different volume class ranges based on per acre volume estimates. In the mid-1970s, the Forest Service contracted an independent consulting firm to assign volume per acre for all lands on the Ketchikan Administrative Area. This inventory estimated timber and landform conditions based upon aerial photo interpretation. This volume per acre data was stratified into different volume classes which are used to describe the volume range of timber per acre in thousands of board feet (MBF).

Volume Class 3 is forested land which contains less than 8 MBF per acre; examples include unstocked, recently harvested stands and fully stocked, immature stands. Volume Classes 4 through 7 contain trees of merchantable size and with more than 8 MBF per acre. Table Timber-2 displays the volume range for each volume class.

Table Timber-2
Volume Range Within Volume Class Strata (Based on Timber Type Maps)

Volume Class Strata	Range of net sawlog volume (MBF/Acre)
4	8 - 20
5	20 - 30
6	30 - 50
7	>50

SOURCE: Marks 1996

Volume Estimates

Stand inventory data contributing to the original volume per acre data, was composed of on-the-ground evaluations of stand characteristics and capabilities. For the Project Area, the Ketchikan Ranger District contracted stand examination plots, supplementing the original stand inventory throughout the Project Area. These stand exam plots were randomly distributed throughout all of the initial Logging and Transportation Analysis (LSTA) identified harvest units (potential harvest unit pool).

Based on the above analysis, this data is relevant for Project Area estimations and is an adequate predictor of volume per acre by volume class. Table Timber-3 displays the net volume per acre (including an estimation of utility volume) by volume class.

Table Timber-3
Estimated Average Net Volume per Acre (including Utility) by Volume Class

Volume Class			
4	5	6	7
25,084 BF/A	31,462 BF/A	41,031 BF/A	45,225 BF/A

SOURCE: C. Grundy 1996

BF/A = board feet per acre

These volume per acre figures were used to calculate planned harvest unit volumes in the development of Table Timber-4 and to develop mid-market calculations later in this section.

Timber: Effects of the Alternatives

Approximately 53 percent of the Potential Harvest Units in the Project Area is Volume Class 4; 37 percent is Volume Class 5; ten percent is in Volume Class 6 ; and none identified in Volume Class 7.

Table Timber-4
Proposed Harvest Volume by VCU and Alternative

			Total MBF Volume			
VCU	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
737	0	11,202	0	6,335	0	0
744	0	48,415	31,223	44,016	31,982	16,969
746	0	1,522	1,514	617	370	1,559
Total Unit Volume	0	61,143	32,738	50,968	32,352	18,528
Right-of-Way Volume*	0	1,429	855	1,846	747	0
Total Volume	**0**	**62,572**	**33,592**	**52,814**	**33,099**	**18,528**

Source: Ketchikan Area GIS, Oien, Trulock, Marks 1996

* Right-of-way volume calculated using average volumes per acre by alternative and adjusting for right-of-way through muskegs and low volume timber stands. Includes temp road volume outside units.

A result of the harvest of timber, as identified in designed harvest units, is the harvest of timber within designated right-of-ways (ROW). ROWs are designed to be the most economical access to the present and future timber resource; in line with protecting and serving other resource needs and meeting Forest Service Standards and Guidelines. Consequently, the volume and type of timber harvested within ROWs is considered incidental to the proposed timber harvest. Table Timber-4 displays the estimated volumes of ROW timber proposed for incidental harvest with each alternative. These estimates were generated electronically, from Timber Type maps, through the Ketchikan Area's Geographic Information System (GIS). Actual area and volume will be established prior to the offering. For more ROW information see the Roads and Facilities Section of this chapter.

Proportionality Analysis

The Tongass Timber Reform Act (TTRA 1990) modified the Long-term Timber Sale Contracts in Alaska to "*...eliminate the practice of harvesting a disproportionate amount of old-growth timber by limiting the volume harvested over the rotation in volume class 6 and 7.*" The Forest Service developed the Forest Service Handbook procedures and implementation instructions for conducting proportionality analysis in January 1992, and updated the procedures in August 1993. The calculation of proportionality is based on dividing the Timber Type Map (TIMTYP) high volume class acres by the total volume class acres within a Management Area. The proportionality in a Management Area after timber harvest is compared with the proportionality calculated for December 1990 conditions to verify that TTRA is satisfied.

The Kelp Bay Timber Sale (Record of Decision February 1992) was the first timber offering completed using the proportionality analysis as directed by Forest Service Handbook (FSH) guidelines. A lawsuit was brought against the Forest Service challenging this method. In April 1994, the federal district court ruled in favor of the plaintiffs (Wildlife Society, et al. v. Barton, J93-001 CV, D. Alaska) and directed the Forest Service to develop a more accurate method of calculating proportionality for the purpose of TTRA based on timber volume, or to better explain its reasons for rejecting the methods proposed by plaintiffs.

In response, the Forest Service developed a transition method of calculating volume-based proportionality using existing timber inventory information (*Alternatives to Using the Timber Type Map for Determining Proportionality Under the Tongass Timber Reform Act*, Wilson and Golnick, 1995). Upon review by the plaintiffs, they requested that the transition method not be implemented pending findings of a pilot study being conducted by Enserch Environmental Corporation in Management Area K15 of the Control Lake Project Area (*Evaluation of Photo-Point Inventory Methods for the Estimation of Timber Volume and Proportionality in Southeast Alaska*, Foster Wheeler Environmental Corporation with Harza Northwest, 1995). This study was based on previous methods identified by Wilson et al. which look at the feasibility of using double sampling methods in association with existing stand exam data. Based on the need for additional information and evaluation of this study, the Forest Service extended the original contract with Foster-Wheeler Environmental Corporation to test the accuracy of the low-altitude photo measurement procedure. Their report, *Estimation of Timber Volume in Southeast Alaska Using Low-Altitude Fixed Base Aerial Photography* (Foster Wheeler Environmental Corporation with Richard A. Grotefendt. 1996) is currently being assessed by the Forest Service. Further negotiations with litigants have been proceeding. Until a final agreement is reached, and updated FSH guidelines are established, the Upper Carroll FEIS proportionality analysis will follow the procedures established in the current FSH as well as the transition method that was developed by Wilson in 1994.

Proportionality Analysis Method FSH 2409.18-93-3

Using the procedures outlined in the Forest Service Handbook (FSH) (1993), the proportion of Volume Classes 6 and 7 were calculated for Management Areas K32 and K35. The change in proportionality from the base percentage of 1990, resulting from harvest activity since 1990, and the change from the 1990 base resulting from the subtraction of the proposed harvest acres for each alternative are displayed in Table Timber-5. The base proportions presented here are different from that presented in the Forest Service Handbook. This difference is due to the use of project-specific information, updated GIS coverages for the Project Area, and an analysis based on polygon coverages rather than point grid coverages. As such, it represents an incremental improvement to the proportion presented in the Forest Service Handbook. Selection of Alternative 1 (No Action) would maintain the existing proportion for K32 and K35.

In the following table, alternatives are within the required proportion if the ''change from base'' value is positive. If the ''change from base'' value is negative, the alternative is out of proportion.

Table Timber-5

Proportion of Volume Classes 6 and 7 Proposed for Harvest by Management Area as Described by Proportionality Analysis Method FSH 2409.18-93-3

	Total Timber Base (acres)	Class 6 & 7 (acres)	Proportionality (percent)	Difference (percent)1/
Management Area K32				
TTRA Baseline (on November 28, 1990)	83,049	7,328	8.82	
Post TTRA Harvest	76,084	6,812	8.95	+0.13
Alternative 1	76,084	6,812	8.95	+0.13
Alternative 2	74,138	6,578	8.87	+0.05
Alternative 3	75,060	6,637	8.84	+0.02
Alternative 5	74,486	6,572	8.82	+0.00
Alternative 6	75,064	6,666	8.88	+0.06
Alternative 7	75,543	6,711	8.88	+0.06
Management Area K35				
TTRA Baseline (on November 28, 1990)	47,314	2,552	5.39	
Post TTRA Harvest	46,058	2,552	5.54	+0.15
Alternative 1	46,058	2,552	5.54	+0.15
Alternative 2	46,008	2,552	5.55	+0.16
Alternative 3	46,008	2,552	5.55	+0.16
Alternative 5	46,038	2,552	5.54	+0.15
Alternative 6	46,046	2,552	5.54	+0.15
Alternative 7	46,008	2,552	5.55	+0.16

SOURCE: Nightingale, Marks, 1996

1/ A positive difference indicates that the percent of Volume Classes 6 and 7 remaining in the Management Area is higher than the TTRA baseline. A negative difference indicates a lower percentage than the TTRA baseline.

All Alternatives for Management Area K32 and K35 will continue to exceed the base proportion of 8.82 and 5.39 percent using Proportionality Analysis Method FSH 2409.18-93-3. For K32, Alternatives 6 and 7 exceed the base proportion by a difference of +0.06 percent. Alternative 2 exceeds the base proportion by a difference of +0.05 percent. Alternative 3 exceeds the base proportion by a difference of +0.02 percent. Alternative 5 equals the base proportion.

For K35, Alternatives 2, 3, and 7 exceed the base proportion by a difference of +0.16 percent. Alternatives 5 and 6 exceed the base proportion by a difference of +0.15 percent. All of the alternatives for Management Area K35 will continue to meet the base proportion of 5.39 percent and will actually improve it. Thus, all alternatives meet or exceed the TTRA proportionality requirement, using the original method.

Transition Proportionality Analysis Method

The Transition Proportionality Analysis Method developed by Wilson and Golnick in 1994, uses the methodology of adjusting the total acres of each volume class to correct for inaccuracies in the TIMTYP mapping of volume classes present at the local level. This adjustment is based on previously collected field data for each Administrative Area. The acres in each volume class are then multiplied by the average volume per acre for each volume class (also based on Administrative Area field data) to calculate the total volume present in each volume class. The volume of volume classes 6 and 7 is then divide by the total volume present in volume classes 4 through 7 to determine the proportion of high volume with the management area.

This approach differs from the acreage-based approach in two ways. First, this approach uses volume instead of acres to determine the proportion. Second, the process includes an adjustment to account for incorrectly mapped stands in all volume classes. Because this approach is based on volume, and volume per acre varies between volume classes, harvest of volume class 7 acres will have a greater effect on proportionality than harvest of Volume Class 6 acres. Similarly, harvest of Volume Class 5 will be more effective in meeting the proportionality requirement, acre per acre, than the harvest of Volume Class 4.

Table Timber-6
Proportion of Volume Classes 6 and 7 Proposed for Harvest by Management Area as Described by Transition Proportionality Analysis Method

	Total Timber Base (MBF Vol)1/	Class 6 & 7 (MBF Vol)	Proportionality (percent)	Difference (percent)2/
Management Area K32				
TTRA Baseline (on November 28, 1990)	2,120,769	789,617	37.2	
Post TTRA Harvest	1,943,069	732,155	37.7	+0.4
Alternative 1	1,943,069	732,155	37.7	+0.4
Alternative 2 3/	1,891,015	712,647	37.7	+0.5
Alternative 3	1,915,206	724,584	37.8	+0.6
Alternative 5	1,898,714	712,159	37.5	+0.3
Alternative 6	1,914,476	718,360	37.5	+0.3
Alternative 7	1,926,796	724,238	37.6	+0.4
Management Area K35				
TTRA Baseline (on November 28, 1990)	1,126,040	243,088	21.6	
Post TTRA Harvest	1,098,803	243,088	22.1	+0.5
Alternative 1	1,098,803	243,088	22.1	+0.5
Alternative 2	1,097,799	242,921	22.1	+0.5
Alternative 3	1,097,799	242,921	22.1	+0.5
Alternative 5	1,098,585	243,088	22.1	+0.5
Alternative 6	1,098,700	243,088	22.1	+0.5
Alternative 7	1,097,799	242,921	22.1	+0.5

SOURCE: Nightingale, Marks, 1996

1/ Total Timber Base volumes derived from TIMTYP Data Layer using Transition Method of adjustment.
2/ A positive difference indicates that the percent of Volume Classes 6 and 7 remaining in the Management Area is higher than the TTRA baseline. A negative difference indicates a lower percentage than the TTRA baseline.
3/ Project Alternative volumes derived from site-specific stand exam net volumes.

Using the Transition Analysis Method for determining proportionality, Alternative 3 in Management Area K32 will exceed by 0.6 percent, Alternatives 1 and 7 will exceed by +0.4 percent, Alternatives 5 and 6 will exceed by +0.3 percent, and Alternative 2 will exceed by +0.5 percent.

For Management Area K35, all Project Alternatives meet the Transition Method for determining proportionality by a difference of +0.5 percent. All of the alternatives for Management Area K35 will continue to meet the proportionality requirement of 21.6 percent. Thus, all alternatives meet or exceed the TTRA proportionality requirement, using the transition method.

Cumulative Effects

Cumulative effects result from the incremental effect of an action when added to the past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor, but collectively significant actions taking place over a period of time. This section summarizes the effects of the proposed Upper Carroll harvest upon the environment in combination with the effects of past and proposed future actions.

The earliest commercial timber harvest within the Project Area was limited to easily accessible coastal shorelines located at the head of Neets Bay. In the early 1960s, the development of a small road system and LTF at the head of Carroll Inlet led to the harvest of approximately 1,074 acres.

The suitability analysis performed for this project (see Affected Environment) identified a total of 7,945 acres of suitable forest land, with 1,428 acres previously harvested and available for future harvest (these acres are not available for this Project).

Table Timber-7 displays the acres and percentage of each volume class proposed for harvest, by alternative.

Table Timber-7
Distribution Percent and Acres, for Proposed Harvest Units by Volume Class and Alternative

	<Vol. Class 4*		Vol. Class 4		Vol. Class 5		Vol. Class 6		Vol. Class 7		Total
Alt.	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres
1	0	0	0	0	0	0	0	0	0	0	0
2	218	11	665	33	879	44	234	12	0	0	1,996
3	139	13	379	35	381	35	175	17	0	0	1,074
5	165	10	457	28	756	47	240	15	0	0	1,618
6	120	12	248	24	518	50	146	14	0	0	1,032
7	87	15	101	17	302	51	101	17	0	0	591

SOURCE: GIS/Nightingale, Marks 1996

* Although smaller portions of a harvest unit may be less than Volume Class 4, they are often included for harvest as a result of not being easily delineated for exclusion.

Swan Lake-Lake Tyee Intertie Project

The Swan Lake-Lake Tyee Intertie Project (DEIS, March 1996) currently overlaps the Upper Carroll Project Area and could increase the overall harvest within related VCUs 733 and 744 by less than two percentage points for Alternative 2; for Alternative 3, two percent; for Alternative 5, less than two percent; for Alternative 6, 2.5 percent; and for Alternative 7, one percent.

Units 13, 57, 72, 76, 77, 83, and 138 harvesting options could be directly affected by increased safety hazards associated with flying logs over and adjacent to the transmission line. Other potential impacts are increased logging costs associated with modifying helicopter flight patterns to avoid the line, additional roading (if feasible) if settings are isolated by the transmission line crossing units, or elimination of those settings within units if isolated and roading proves unfeasible.

Table Timber-8 displays the acres and volume by alternative and VCU that would be in addition to the Upper Carroll Project should the Swan Lake-Lake Tyee Intertie Project occur prior to any harvest offered within the Upper Carroll Project Area.

Table Timber-8
Additional Harvest within the Upper Carroll Project Area

	Alt. 2		Alt. 3		Alt. 5		Alt. 6		Alt. 7	
VCU	Acres	MBF	Acres	MBF	Acres	MBF	Acres	MBF	Acres	MBF
737	9	361	0	0	0	0	0	0	0	0
744	40	815	24	707	31	815	31	815	6	189
Totals	**49**	**1,176**	**24**	**707**	**31**	**815**	**31**	**815**	**6**	**189**

Acres and Volumes based on GIS TIMTYP Layer

Source: GIS, Marks, 1996

Projected Harvest through Completion of the KPC Long-term Contract, 2004

By the year 2004 (when the Long-term Contract with KPC expires), approximately 24 percent of the suitable base is scheduled for harvest. The scheduled acreage in Alternative 2, combined with the acreage previously harvested (1,428 acres of second-growth), equals approximately 42 percent of the suitable base. Between the end of the Long-term Contract in 2004, and by the end of the forest rotation in approximately 2140, all suitable volume would be scheduled for harvest to attain the desired future condition. Future timber harvest within the Project Area could occur as summarized in Table Timber-9.

Table Timber-9
Direct, Indirect, and Cumulative Effects of Timber Entry into Project Area

Alt.	Acres of Proposed Harvest	Percent of Suitable (Direct)	Acres of Potential Harvest 2000-2004	Total Percent Suitable 2004 (Indirect)	Acres of Future Harvest 2004-2140	Percent of Suitable 1955-2140 (Cumul.)	Percent of CFL Harvested 1955-2140
1	0	0	1,996	19	5,949	57	28
2	1,996	19	0	19	5,949	57	28
3	1,074	10	922	19	5,949	57	28
5	1,618	16	378	19	5,949	57	28
6	1,032	10	964	19	5,949	57	28
7	591	6	1,405	19	5,949	57	28

SOURCE: GIS/Nightingale, Marks

Falldown

Falldown refers to the difference between planned or scheduled harvest and that which is attained after implementation. Falldown can be categorized in terms of hard falldown and soft falldown (short-term deferral of harvest), and can be further grouped into four types of falldown factors. Most falldown is encountered during field verification of proposed units and roads. Therefore, by conducting field verification prior to sale layout, most falldowns can be determined and accounted for early in the planning process.

Hard Falldown (Suitability Factors)

Hard falldown from the current Forest Plan (1979, as amended) occurs during harvest unit planning/design, layout, and at the time of harvesting and results in changes to the suitable timber base. Examples of hard falldown include reserve tree area selections, additional levels of resource protection, Class 1 and 2 (TTRA) stream buffers, logging feasibility, local areas of poor soil stability, rock outcrops, V-notches, noncommercial forest sites, and sites that cannot be reforested in five years. Hard falldown also includes lands required for buffers along previously unmapped streams and lands selected by the State or Native Corporations that have been conveyed to their ownership.

For the Upper Carroll Project Area, hard falldown due to suitability factors listed above, was estimated at 47 percent of the tentative suitable base. This estimate is based on the logging system and transportation analysis, on-the-ground reconnaissance, stand exam data, watershed analysis data, and preliminary unit layout and design. This 47 percent estimate of hard falldown is considerably higher than other falldown studies. Other studies analyzed a larger geographic portion of the Forest and are thought to more accurately reflect the impacts of falldown across the entire Tongass National Forest, including the Ketchikan Area. Soft falldown due to differences between planned and actual unit acres are expected to be significantly less due to the high level of field reconnaissance during the NEPA process.

Areas that create hard falldown are mapped and entered into the appropriate databases that are used to adjust the suitable acreage for the Forest. These adjustments ultimately affect the Forest database from which the Forest Plan allowable sale quantity (ASQ) is calculated. It should be noted that field verification and office analysis also identified some areas mapped as unsuitable that qualify to be included back in the suitable timber base. These additional areas have been mapped and entered back into the suitable database. Recent project experience indicates that the total acres added back to the suitable base tend to be small in proportion to the areas removed.

Soft Falldown

Soft falldown occurs during harvest unit planning/design, layout, and occasionally at the time of harvesting. Areas that create soft falldown are generally short-term deferrals (5-10 years) and typically do not affect the Forest Plan ASQ data base.

(Standards and Guidelines Deferral, Harvest Type, and Economic Factors)

Forest-wide Standards and Guidelines and federal regulations are a primary cause of soft falldown. Examples of soft falldown caused by land use factors include: deferring potential harvest units adjacent to previous harvest areas that have not reached sufficient new tree growth to meet National Forest Management Act (NFMA) created opening requirements; deferring potential harvest units in areas/watersheds that have exceeded Forest Plan cumulative effects thresholds; and deferral of potential harvest units to meet Tongass Timber Reform Act of 1990 (TTRA) proportional harvest requirements.

Short-term deferral of harvest to meet Forest-wide Standards and Guidelines will likely be necessary in the future in areas with high levels of previous harvest. Cumulative watershed, visuals, and TTRA proportional harvest requirements are some of the objectives that can be met through short-term deferrals.

Selection of harvest types other than clearcut also leads to soft falldown. Harvest types other than clearcut are sometimes prescribed for protection of natural resources and amenity values. This results in timber volume being retained in the unit for either the short term (e.g., overstory removal with subsequent entries) or the long term (e.g., snag, green tree, or seed tree retention).

Soft falldown due to economic factors occurs when suitable lands are deferred from harvest due to low cost effectiveness. Lands that require many miles of new road construction or expensive yarding systems (i.e., helicopter) are included in this group. These areas remain available for harvest in the future, when economic conditions permit. Soft falldown could result in lower harvest figures than those shown in previous projects.

Interim Changes in Land Use

Emerging land-use issues have the potential to change the future timber supply. This may include deferring potential harvest units (or portions of units) to meet newly defined resource objectives that have not been included in the Forest Plan. An example of this are areas deferred from harvest for protection of karst ecosystems.

Interim changes in land uses have the potential to result in revised land-use allocations under the Forest Plan. Once forest planning adopts revised land uses, the suitable land base, from which the ASQ is calculated, will be adjusted as necessary. These changes in Forest-level planning are not referred to as falldown.

Pursuant to Section 301(e) of the Tongass Timber Reform Act of 1990, the Irland Group was contracted by the Forest Service to prepare an ''Assessment of Adequacy of Timber Supply and Analysis of Potential Effects of Eliminating the Long-term Timber Sale Contract Area'' (The Irland Group 1991). The Forest Service responded with an ''Evaluation of the Irland Group Report'' in April 1992 (USDA Forest Service 1992c). Both documents include evaluation of falldown factors. The Irland Group estimated potential falldown at 23 percent of the maximum permitted ASQ; the Forest Service estimate was 31 percent. The Forest Service estimate was further subdivided to identify 21 percent soft falldown and 10 percent hard falldown. The Irland Group Report, the Forest Service Response to the Irland Report, recent falldown estimates from field verified timber sales, and projections of future falldown and changes in land use are discussed by falldown category.

Harvest Type Factors

The use of harvest prescriptions other than clearcut is likely to continue into the future due to concern for amenity values such as visual quality and protection of recreational sites. This will result in falldown from current Forest Plan projections.

The Upper Carroll Project Area will experience a falldown of approximately three percent reduction in volume over the entire unit pool due to implementing harvest methods other than clearcutting.

Falldown in other project areas such as Painted Peaks Timber Sale and North Revilla Project Area where harvest prescriptions other than clearcut were used experienced a three to five percent reduction in volume over the entire Project Area.

Leading Economic Risk Factors

Economic falldown is dependent on changing economic conditions including log prices, cost of accessing harvest units (roads), and efficiency of harvest systems which includes yarding and hauling costs. It varies considerably over the short and long term and its effect on overall timber supply is difficult to quantify accurately. Falldown due to economic factors was estimated by the Forest Service at 21 percent under recent economic conditions (USDA Forest Service 1992c). For the Upper Carroll Project, economic falldown was evaluated by using Alternative 3 as the baseline for comparison against all other action alternatives.

This is due to: (1) Alternative 3 is designed as the most economically viable alternative for the project, and (2) the risk of economic falldown for Alternative 3 is considered very low due to having a positive rate of return for both the Mid-market and Current-market Analysis. Table Timber-10 is based on the Table Socio-Economic-4, Mid-market Break Even Analysis, Socio-Economic Environment Section.

Table Timber-10
Alternative Risk Assessment for Economic Falldown

	Percentages				
	Alt. 2	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Shelter Cove Road Tie and LTF*	25.6				
Project Area Preferred LTF **	12.2	0	12.4	5.4	6.7
Neets Bay Watershed***	37.1		26.9		

* Shelter Cove LTF with Road Tie applies to Alt. 2 only
** Upper Carroll Preferred LTF which requires reconstruction of an existing site.
*** Neets Bay only assesses economic risks for units harvested under Alternatives 2 and 5 within the Neets Bay watershed.

Source: Marks, 1996

The high direct costs associated with harvesting units within the Neets Bay watershed poses the highest risk of economic falldown (see Table Timber-12, Summary of Mid-market Stump to Truck Logging Costs and Pond Values/MBF by Volume Class Strata, Timber Section, and Table Socio-Economic-4, Mid-market Break Even Analysis, Socio-Economic Environment Section). Since some or all of the Neets Bay harvest units are included in Alternatives 2 and 5, the overall risk of economic falldown for these Alternatives are also increased.

Alternatives 6 and 7 show an increased possibility of economic falldown as compared against Alternative 3 but less than Alternatives 2 and 5. This is due to a slight positive rate of return from the Current-market Analysis (See Table Socio-Economic-6, Summary of Estimated Costs and Profits by Alternative Current-market Analysis, Socio-Economic Environment Section).

The actual final economic falldown depends on how offering area boundaries are defined. In some cases, economic falldown can be reduced or minimized if lower value areas can be combined with higher value areas.

Ketchikan Area Database Update

In order to more closely estimate potential falldown and change in land use factors, the Ketchikan Area is currently updating several resource databases. Stream databases will be updated to better represent conditions being found during ground verification and project implementation. Additional analysis of slopes, landslides, and V-notches in conjunction with soils will help identify areas that often are inoperable for logging. Logging and transportation analysis for future projects will be performed to quantify how much of the suitable timber base is in the more expensive economic category. The Ketchikan Area update was designed specifically to help address the areas of potential changes in timber supply discussed above and is expected to provide more precision to the quantification of potential falldown and changes in land use. The falldown figures used in the Upper Carroll Project Area are based on ongoing project analysis and are expected to fall within a reasonable range of the Ketchikan Area update results. The Ketchikan Area update information was used by the Tongass Land Management Planning Team for the TLMP RSDEIS (1996a) process.

Logging Systems

Yarding is the process of conveying logs from the stump to the landing. This can be done using ground-based equipment, cable logging systems, or helicopters. The method used depends upon many factors including access, topography, slope, and resource protection needs (log suspension requirements).

Ground Based Yarding

Moist, soft soil conditions in relation with steep slopes found in the Project Area prove difficult for ground-based equipment operation. Except for a limited amount of shovel logging with track mounted log loaders, there has been little opportunity for this type of equipment.

Shovel Yarding

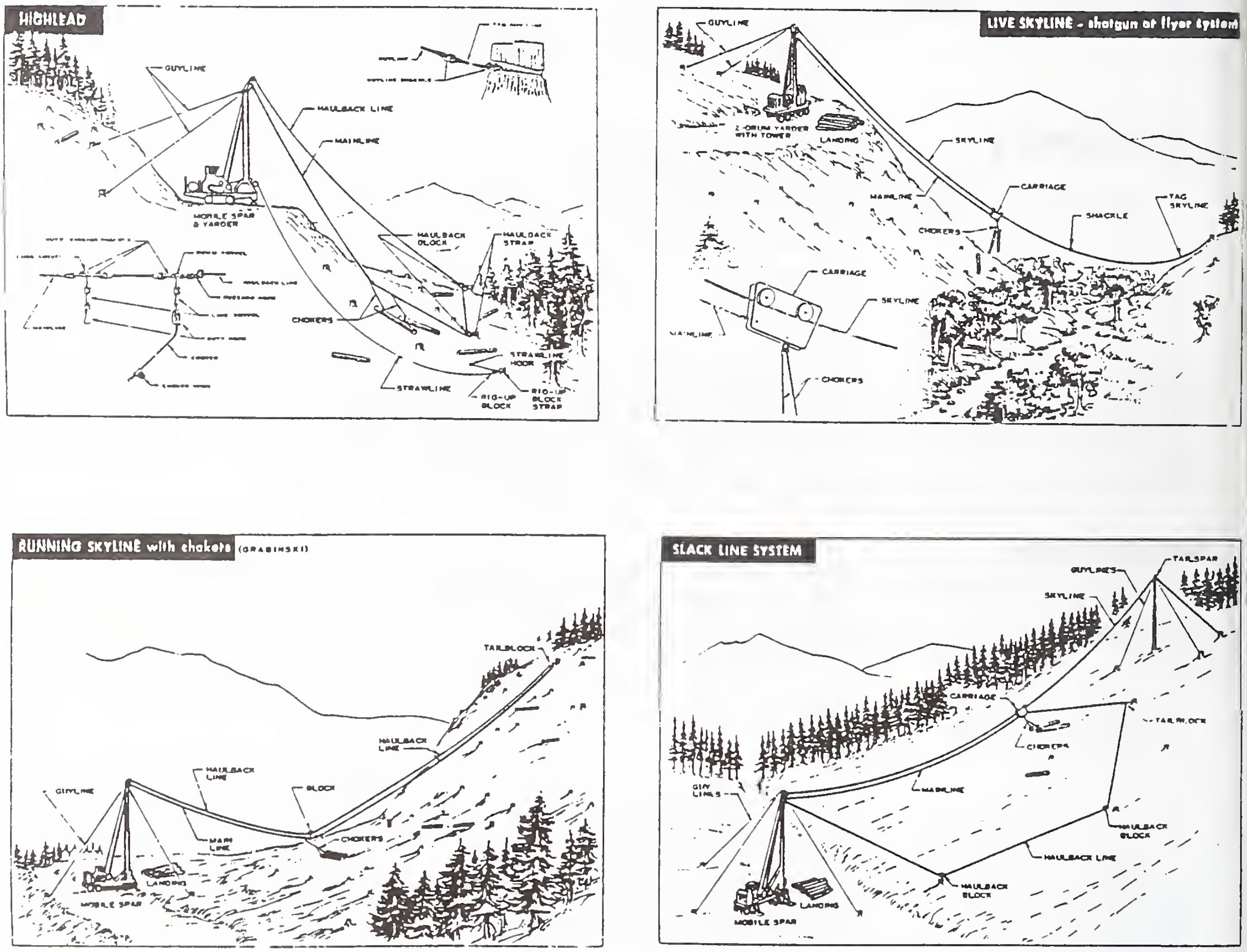
Shovel logging with hydraulic log loaders has added a new dimension to ground based yarding systems. Larger tracks and a lower center of gravity make these machines more stable, lighter, and agile. They also produce a lighter footprint or ground pressure. Partial suspension requirements are met by this type of yarding system. Shovel yarding is a system of short-distance logging in which logs are moved from the stump to the landing by repeated swinging with a swing-boom log loader. The loader is walked off the haul road and out into the harvest unit. Logs are moved and decked progressively closer to the haul road with each pass of the loader. When logs are finally decked at roadside, the same loader, or a different loader, loads out trucks. On gentle ground (less than 20 percent slope), logs are either heeled and swung or dragged by the boom as it rotates. While the Project Area LSTA process classified units as either cable or helicopter yarded, certain portions of cable units, especially along ROWs, were identified suitable for shovel yarding. Currently, approximately ten percent of an offering area is being shovel yarded. The decision to actually specify shovel yarding within a given unit is made at the time of unit layout.

Cable Yarding

Cable yarding throughout the Ketchikan Area is comprised of approximately 20 percent slackline yarding, 30 percent running skyline, and 35 percent highlead (Marks 1992). On the Project Area, highlead (Grabinsky or rider block) and small skyline systems (rigged live or running) account for the majority of the timber harvest methods proposed in each alternative. These yarding systems inherently provide partial suspension or log lift in a majority of uses, but when required, a system capable of providing increased log suspension is identified to meet required management objectives. Figure Timber-4 displays four systems of cable yarding.

The Forest Service plans and appraises for the most economical yarding system feasible for a particular harvest setting provided it meets management objectives and suspension requirements for the unit. Within the planning process, the running skyline yarding system is used in place of highlead yarding because it is more economical. If at the time of actual unit layout there are no management objectives that require partial suspension (increased log suspension), the highlead yarding system may be utilized.

Figure Timber-4
Cable Yarding Systems



Highlead Systems

Highlead systems (including Grabinsky or rider block) were previously used more than any other cable system. A two-drum yarder is used. These yarders are typically 90 to 110 foot towers which have telescoping tubes and are tied down with six or eight cables or guywires. One drum holds the mainline which attaches to butt rigging with chokers. The other drum holds the haulback line which supports the rider or bull block. The haulback also continues on through a block (pulley) and attaches to the other side of the butt rigging. The mainline and haulback control the inhaul and outhaul of the butt rigging. The term highlead refers to the location of the mainline block which is elevated above the ground by the spar. The mainline block (bull or rider block) provides some vertical lift enabling logs to override obstacles, thus minimizing soil disturbance as a ''turn'' of logs is inhauled to the landing. This system provides some partial suspension and is usually designated in areas that have minimal risk of soil disturbance. This system's maximum yarding distance is 1,500 feet uphill and 600 feet downhill. Additional suspension requirements, as well as entry into more difficult terrain requiring longer reaches, favors other systems with expanded capabilities.

Most of the timber in the Project Area will be removed with cable yarding equipment.

Running Skyline Systems

Running skyline systems require a three-drum ''swing'' or tower yarder which include a mainline, haulback, and slackpulling lines with hydraulic interlocking capabilities. These yarders are typically shorter (50 to 70 feet) and in the case of a swing yarder, are usually a leaning lattice type tower that can swing to either side allowing a turn of logs to swing toward a log loader. The interlock system hydraulically ties all three drums together (which rotate at different speeds) to increase overall lifting capability, especially when rigged in a downhill yarding configuration (where braking the haulback line provides the actual log lift or suspension). This system can utilize either a mechanical slack pulling carriage or a mechanical grapple. Both are directly supported by the haulback line. When a grapple is utilized, the slackline and mainline drums control the operation of the grapple which open and close around selected logs which in turn, are yarded to the landing. When a mechanical slack pulling carriage is utilized, the same two drums are used to control the inhaul or outhaul of the skidding line/chokers. While each type of carriage is in common use and provide distinct production advantages, they both provide partial suspension capabilities required to meet most soil management objectives. This system inherently provides increased log lift due to its hydraulic interlocking capabilities. Maximum yarding distance is 1,000 feet uphill and 600 feet downhill.

Live Skyline (Shotgun/Flyer) Systems

Live skyline (shotgun/flyer) systems feature a moving skyline cable which raises and lowers a simple carriage with chokers to a turn of logs. The mainline on a highlead yarder (two drum tower) is used as the skyline and the haulback is used as the mainline, to control carriage inhaul/outhaul. The carriage is gravity outhauled with the mainline controlling both inhaul and outhaul. The term shotgun refers to the high speed that the carriage reaches while outhauling to a turn of logs. The skyline/carriage is then lowered to allow the logs to be choked for inhaul to the landing. This system provides good suspension or log lift to meet management objectives of partial or full suspension requirements. Maximum yarding distance is 1,500 to 2,000 feet uphill.

Slackline Systems

Slackline systems are a configuration of live skyline systems. A three-drum yarder (tower) includes a skyline, mainline, and a haulback for the inhaul/outhaul of a simple carriage with chokers attached. The main difference is that a haulback line rather than gravity is used to outhaul the carriage. Slackline systems provide excellent lifting capabilities and are employed when management objectives require full or large areas of partial suspension to avoid soil disturbance. Maximum yarding distance is 2,000 to 2,500 feet uphill or 1,000 feet downhill.

Standing Skyline (Long Span) Systems

Standing Skyline (long span) systems are similar to a live skyline system. Long-span skyline is the most common and has two main differences. The first is a non-moving skyline, and the second is the use of a radio controlled carriage. A radio-controlled carriage is used with a two-drum yarder (large towers 90 feet or greater) which employs the use of a skyline and a mainline to support the carriage and to provide inhaul. The radio-controlled carriage has an internal engine which provides the pulling power to skid or inhaul the logs to it. Outhaul of the carriage is by gravity. Skidding line outhaul is controlled by radio; the carriage is stopped and clamped above a turn of logs where the skidding line is dropped to choke the logs. The carriage is then commanded to skid or inhaul the logs up to it where the yarder's mainline inhauls the carriage with the suspended logs to the yarder. This system is used when yarding distances of up to 5,000 feet are required. Shorter span versions of this system include the use of three-drum yarder-controlled carriage or a more simple falling block type carriage which utilizes a two-drum yarder. These include the North Bend (uphill yarding), South Bend (downhill yarding), and the multi-span system (uphill yarding). The multi-span system utilizes intermediate skyline support jacks similar to those found in ski lodge chair lifts. These enable the carriage to carry a load of logs over a topographic break in slope which would otherwise be a blind lead (the skyline bites into the ground). These systems provide excellent lift and log suspension in areas that require full or partial suspension to meet management objectives.

Helicopter Yarding

Helicopter yarding is proposed in all Alternatives. Helicopter yarding has been successfully used on all areas of the Tongass National Forest within recent years. On the Ketchikan Administrative Area, Revilla Island, the Painted Peak Timber Sale (4 MMBF), certain portions of the Brown Mountain Timber Sale, and large portions of the North Revilla Project Area were helicopter yarded. With this system, logs are lifted off the ground (fully suspended) and flown to a specially prepared landing. This yarding system causes the least amount of ground disturbance of all the yarding systems, but has the highest yarding cost. The economic feasibility of helicopter yarding is more closely affected by market values than cable yarding. Maximum yarding distance is regulated by economics. Helicopter flight time costs between $2,000 and $5,000 per hour. Maximum flight time between loads or turns of logs is approximately three minutes. Factors that affect flight time and economic feasibility include, elevational differences between stump and landing, logs/volume per acre, species mix and subsequent value, and payload capabilities of the aircraft.

Table Timber-11
Distribution Percent of Proposed Yarding System by Acres per Alternative

Yarding Type	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt 7
Running Skyline (RS)	0	56	67	55	51	0
Highlead (HL)	0	18	22	18	17	0
Slackline (SL)	0	2	2	2	1	0
Helicopter (HE)	0	16	3	16	26	100
Live Skyline (LS)	0	5	3	7	3	0
Shovel (SH)	0	3	3	2	2	0

SOURCE: GIS, Marks 1996

Effects of Proposed Yarding Systems

All yarding is proposed in conformance with national and regional standards and guidelines. Yarding systems were assigned to settings in an interdisciplinary process to minimize any potential or foreseen effects. On-site ground reconnaissance and actual field evaluations during the EIS and Layout process will ensure the yarding system assigned will provide the required suspension to meet management objectives as specified by reviewing specialists. For effects analysis see the Soils section of this chapter.

Reserve Tree Selection Guidelines

In 1993, a committee was formed that included members from Industry, the Forest Service, and the Alaska Department of Labor, Occupational Safety and Health Administration (OSHA), to develop guidelines in the selection of reserve trees. Their main objective was to provide a technical framework to achieve safer working practices in concert with forest and wildlife management goals. The Reserve Tree Selection Guidelines booklet (USDA, Forest Service, Alaska Region R10-MB-215, March 1993) is dedicated to the principal that no worker shall be exposed to a danger tree.

These guidelines are used in both the Upper Carroll planning process as well as during the layout process for project implementation. The reserve tree selection criteria process described in the Silviculture Section implement many of the technical guidelines recommended by the committee.

Elements of successful reserve tree planning include definitions and strategies for selecting reserve trees that are compatible with safe, modern forest practices. Long-range planning on a large scale allows more design options for safe ways to reserve trees for meeting wildlife needs.

The arrangement of reserve trees is key to meeting distribution objectives in a manner compatible with safe work practices. Uniform distribution of reserve trees on every acre is not necessary. Reserve trees can be retained along yarding breaks or clumped within the unit to accommodate operational needs. Reserve tree retention on excessively steep slopes (greater than 80 percent) is not always feasible due to limited falling corridors during the cutting stage of the harvest process. Long-range plans should provide criteria for tree selection and distribution that are flexible enough to account for ongoing tree decay processes and changes in harvest plans. Many of the difficulties in retaining reserve trees during harvest can be eliminated through careful site evaluation, considering the specific abilities of harvest equipment and processes, and implementation in both the planning and layout process.

Operational Guidelines

Cable Yarding

The type of yarding system and topography will determine where reserve trees can be safely retained. As a general rule, harvest systems capable of using a slack-pulling carriage are the most able to retain trees within the unit and systems. Systems with no lateral yarding capability and down-hill yarding usually require reserve clumps, groups, and individual trees only be left along the edges of settings.

Systems with Lateral Yarding Capability

In uphill yarding with lateral yarding capability (slack pulling carriage), individual trees, clumps, and groups may be left in mid-setting. To suspend logs over or yard through the reserve areas can only be done if there is sufficient deflection (operating lines must not be within hazard areas- see Reserve Tree Selection Guidelines).

Helicopter Yarding

Helicopter logging allows flexibility to leave reserve trees nearly anywhere in the unit because it can access logs from various directions. However, it creates special problems with rotor downwash, such as flying limbs and chunks. Logs swinging against standing trees during log pick up may also dislodge portions of reserve trees. The hazard area may need to be enlarged to address this increased hazard.

Timber Economics Economic Efficiency Analysis

Current Forest Service Handbook direction FSH 2409.18—Sale Preparation Handbook, WO Amendment 2409.18-95-1, 2, 3, and 4 and further described in the R-10 Supplement No. 2409.18-93-3 requires an economic efficiency analysis to compare benefits and costs of a project. Values used in the analysis must reflect middle market timber value estimates that are based on median or mid-level timber market values. In order to account for market fluctuations, weighted average timber values over the past 10 years are used in this analysis.

Forest Service Handbook (FSH) direction also provides for including an allowance for at least 60 percent of normal profit, which must be included when calculating costs and returns. This economic-efficiency analysis is performed by comparing expected gross revenues against estimated costs and arriving at an estimate of net revenues.

Pond Log Values

Pond log values represent the delivered price of logs at the mill minus the cost to manufacture them into usable products. Pond log values are closely related to volume class data which incorporates log size, grade, and species. On the Ketchikan Administrative Area, the lower volume classes generally have a higher yellowcedar component, which has the highest selling value. On the Project Area, this results in a disproportionately high pond log value for the lower volume classes instead of lower, which would reflect the true value of the high elevation (small diameter, low grade) yellowcedar timber.

Stump to Truck Logging Costs and Pond Log Values

Stump-to-truck logging costs are subtracted from the pond log values to arrive at a delivered price to the mill. Stump-to-truck logging costs include felling, bucking, yarding, loading, and administrative costs. Logging costs are closely tied to volume per acre (represented by volume class data). Generally, the higher the volume per acre the lower the logging cost. Table Timber-12 shows the stump-to-truck logging costs and associated pond values for each volume class.

Table Timber-12
Summary of Mid-market Stump to Truck Logging Costs and Pond Log Values/MBF by Volume Class Strata

	Volume Class (Dollar Amount per MBF)		
	4	5	6
Highlead - Uphill	$195.73	$141.00	$128.71
Highlead- Downhill	$221.65	$157.82	$144.04
Skyline - Running	$173.54	$131.16	$119.86
Skyline - Live	$178.00	$130.19	$119.16
Skyline - Standing (long span)	$241.74	$172.69	$158.18
Slackline	$230.35	$165.29	$151.33
Shovel	$173.66	$125.28	$115.33
Helicopter *	$187.80 - 339.08	$187.80 - 339.08	$187.80 - 339.08
Neets Bay Only **	$524.66 - 537.73	$524.66 - 537.73	$524.66 - 537.73
Pond Log Value	$533.20	$559.38	$489.63
60 Percent Profit Margin	$116.28	$119.16	$115.67
Pond Value less Profit	$416.92	$440.22	$373.96

SOURCE: Marks 1996

* Range of helicopter costs are based on the computer program Helipace (version 2.0) adjusted to R10 costs. The range of helicopter yarding costs by volume class reflect different yarding flight paths and distances required by each alternative. These costs are used for both mid-market and current-market analysis.

** Range of helicopter yarding costs for Neets Bay Helicopter units, Alternatives 2 and 5.

Additional Costs that Affect Timber Sale Economics

In addition to logging costs, other costs related to truck haul, dump, tow, raft, specified road construction and reconstruction, temporary road construction, LTF construction, camp development, and helicopter support costs need to be considered when determining the economics of timber sales. For the purposes of this analysis, stump-to-truck logging costs plus haul, dump, tow, and raft costs, etc., were all combined into a total transportation cost center. All capital investment costs, such as road, bridge, and LTF construction were combined into a total construction cost center. Two LTF site costs are analyzed for the mid-market and current-market analysis. The existing LTF site which requires reconstruction, is the preferred site, and an alternate LTF site, further south, which will require additional road and site development, are displayed in Table Timber-13. Mid-market costs are summarized by alternative. Because Alternative 1 does not propose any timber harvest, it is not displayed in the table.

Total Transportation and Construction Costs by Alternative

Table Timber-13
Summary of Total Mid-market Transportation and Construction Costs, in Dollars

Reconstruction of Existing LTF Site (Preferred)

Alternative	Transportation Costs* ($M)	Construction Costs* ($M)	Total Costs* ($M)	Ave. Cost/MBF
Alt. 2**	18.19	23.47	41.66	$647.29
Alt. 2***	17.05	17.43	34.48	$535.71
Alt. 3	7.68	7.62	15.30	$458.01
Alt. 5	13.87	14.49	28.36	$537.04
Alt. 6	8.91	7.32	16.23	$490.30
Alt. 7	8.02	1.03	9.05	$489.01

New Construction of Alternate LTF Site South of Preferred

Alternative	Transportation Costs* ($M)	Construction Costs* ($M)	Total Costs* ($M)	Ave. Cost/MBF
Alt. 2***	17.05	17.79	34.84	$541.43
Alt. 3	7.68	7.99	15.67	$469.08
Alt. 5	13.87	14.86	28.73	$544.00
Alt. 6	8.91	7.69	16.60	$501.42
Alt. 7	8.02	1.40	9.42	$508.86

SOURCE: Marks 1996

* rounded to the nearest thousand
** Alt. 2 with 10.6 mile road tie to Shelter Cove LTF. No other LTFs used.
*** Alt. 2 without a road tie to the Shelter Cove LTF.

The implications of Table Timber-13 are summarized below:

- Cost per MBF is highest for Alternative 2 with the Shelter Cove road tie ($647.29/MBF). Cost per MBF for Alternative 2 without the Shelter Cove road tie is second highest (535.71/MBF). Both alternatives require substantial amounts of road and longer helicopter flight distances to reach smaller and more isolated units, which results in higher construction and transportation costs per MBF (see Table Timber-13).

- Transportation and construction costs per MBF are lowest for Alternative 3 ($458.01) because less road and bridge construction is required with fewer units helicopter yarded. The logging costs of successive entries can be expected to increase due to the projected increase in the proportion of isolated volume within the Project Area. However, smaller, more efficient timber sales within the Project Area can be designed to take advantage of the existing road system, thereby limiting overall construction costs. Overall, Alternative 3 would decrease the Area's ability to offset the cost of harvesting the difficult and isolated component (see Operability, this section).

- Alternatives 2 and 5 high cost per MBF reflect the increased cost associated with helicopter yarding the units associated with Neets Bay. Helicopter yarding costs of $524.66 to $537.73 per MBF (Table Timber-12) were calculated from the computer program Helipace. These high costs per MBF are a direct result of: above average yarding distances, elevational differences of greater than 2000 feet, support service landing areas (fuel, maintenance, etc.) being located farther than average, and flight path adjustment in Neets Bay to avoid SSRAA facility salmon holding pens located nearby.

- The high costs associated with Alternative 2 reflect the higher costs of having to access more marginal timber to meet the purpose and need of the project. This essentially depicts the higher costs that may be associated with any future entry; harvesting timber in areas increasingly more difficult to road. A future entry, without the volumes of Alternative 2 to carry it, could have a net value lower than this entries Alternative 2.

- All Alternatives include helicopter yarding, which is a more expensive yarding system than cable yarding. Helicopter costs are derived by using the computer program Helipace (version 2.0). The program develops a yarding cost per harvest unit based on unit elevation, landing elevation, type of aircraft, and stand data (volumes, stems/acre, pounds per board foot, etc.). Helicopter payloads and flight distances (flight time) are adjusted by the various input factors to produce the end result of unit yarding days which is further refined to total cost per unit. Unit yarding costs are further adjusted to R10 requirements.

- Alternatives 2, 5, and 7 require the use of a landing barge to facilitate helicopter yarding to a water site (Upper Carroll or Neets Bay). This additional cost was developed by establishing a daily cost for the following job centers: barge tow in and set anchors, barge cost per day, construct bag boom, collect daily log production, burn limbs and slash, and tow barge back to Ketchikan. The bundle and dump of logs was not calculated for this activity as it is covered by normal dump and raft costs within the Forest Service Appraisal System.

Comparison of Alternatives Based on Estimated Mid-market and Current-market Stumpage Values

Estimated net timber value (stumpage) is arrived at by subtracting all associated costs from the pond value for all proposed harvest units in each action alternative. Consequently, individual units which may be uneconomical to harvest by themselves are offset by combining them with other units which are more economical to harvest. This results in less productive land or land where the timber is highly defective being made more economically viable for timber harvest. These lands are then brought under management, thereby increasing future timber yields, and postponing entry into more environmentally sensitive areas.

These projected construction costs, transportation costs, and pond log values are estimates, not actual costs, which form a constant by which all alternatives may be compared. Before the timber is sold, the volume within the units and ROWs will be cruised and appraised, to determine the actual volume and value of the timber. Because all action alternatives are measured against the same yardstick of estimated costs, it is appropriate to rank the alternatives in order by net value. Table Timber-14 shows the estimated value and ranking of each alternative based upon the net value. Net values are shown rounded, since the figures are based on estimates. Because Alternative 1 has no timber harvest costs or values, it is not listed.

Table Timber-14

Summary of Harvest Unit Estimated Stumpage Values by Alternative, per MBF (based on Mid-market and Current-market Analysis Using Preferred Project Area LTF Cost)

Alt.	Estimated Total Volume (MBF)	Total Pond Value*	Total Trans. Costs** ($Millions)	Total Const. Costs*** ($Millions)	Estimated Net Value @ Mid-market	Estimated Net Value @ Current-market	Rank Order
Alt. 2 SC 1/	62.572	$539.48	$18.27	$23.58	-$158.40	-$137.42	6th
Alt. 2 W/O 2/	62.572	$539.48	$17.13	$17.51	-$51.95	-$25.66	4th
Alt. 3	33.592	$534.94	$8.28	$7.62	+$19.06	+$51.05	1st
Alt. 5	52.814	$538.95	$13.95	$14.58	-$53.64	-$33.50	5th
Alt. 6	33.099	$540.18	$8.96	$7.36	-$8.64	+$9.26	2nd
Alt. 7	18.528	$539.13	$8.08	$1.04	-$17.43	+$0.43	3rd

SOURCE: Marks, Oien 1996

* Values are meant for comparative purposes only.
** Transportation costs include all costs not associated with capital investments or costs normally connected to road construction, such as: fall, buck, yard, sort, load, haul, dump, raft and tow.
*** Construction costs include costs associated with LTF development, road construction and reconstruction, such as: pit development, clearing, grubbing, embankment, haul, excavation, and related material, such as bulkheads, bridges and culverts.

1/ With Shelter Cove to Carroll Inlet road tie.
2/ Without construction of Shelter Cove to Carroll Inlet road tie.

Based on this analysis, not all mid-market values for each alternative show positive net stumpage rates. Costs for temporary road construction and specified road reconstruction may fluctuate when updated for the offering appraisal. Changes in logging costs and selling values can also have an undetermined effect on overall stumpage values; changes in these values will not alter the economic ranking of Alternatives. Only modification of an Alternative(s) will alter economic ranking.

Alternative 3 shows the highest relative net stumpage ($19.06/MBF), while Alternative 2 SC (Shelter Cove road tie) shows the lowest (-$158.40/MBF). Further analysis for current-market values indicate a positive return for Alternatives 3, 6, and 7 (see Table Timber-14). However, fluctuations in pond log values or logging/road construction costs may cause net values to change.

Alternative 3 has the highest threshold before becoming a negative net value. Ketchikan Administrative Area combined administrative costs average approximately $16/MBF. At current- or mid-market values, Only Alternative 3 has a cost to prepare and administer which does not exceed estimated net value.

Socio-Economic Environment

Key Terms

Direct effects for employment and income—Those effects that impact sectors either exporting goods and services from the primary zone of influence or selling those products to final consumers within the zone. An example of direct employment would be people working in a sawmill.
Discounted benefits—the sum of all benefits derived from the Forest over the life of a project.
Discounted costs—the sum of all costs incurred from the Project Area during its period of implementation, discounted to the present.
Economic efficiency—a measure of the relationship between discounted costs and discounted benefits, such as present net value or benefit/cost ratio.
Indirect effects for employment and income—Those effects that are linked to the direct effects by providing goods and services to the directly affected sectors. An example of indirect employment would be people who work in a generating plant that sells electricity to a sawmill.
Induced effects for employment and income—The effects that are linked through the direct and indirect effects income that consumers spend within the area. An example of induced employment would be grocery store employees who sell products to the people working in a sawmill or generating plant.
Pond log value—Delivered price of logs at mill minus manufacturing costs.
Present net value (PNV)—the difference between benefits and costs associated with the alternatives.
Primary zone of influence—The area where social, economic, and/or environmental conditions are significantly affected by change in forest resource production or management (Ketchikan).
Public net benefits (PNB)—A measurement of economic efficiency. PNB are the sum of present net value and nonpriced commodities (such as scenic quality and community stability).

Affected Environment

This section provides a baseline for evaluating the economic and social condition of the Upper Carroll Project Area. It is followed by an assessment of potential effects that could result from implementing a project alternative. Included is a discussion of regional employment and income, returns to the federal treasury, payments to the state, economic efficiency, sales below cost, non-market and non priced values, and cumulative effects.

The primary zone of influence is defined as the area where change will have a direct effect on employment and income. This zone of influence for the purpose of this economic analysis is the region around Ketchikan, where the social, economic, and/or environmental condition is directly and significantly affected by changes in forest resource production or management. This area consists of the census areas of the Ketchikan Gateway Borough (AK89-130). Additionally, Saxman was listed in the 1988 Tongass Resource Use Cooperative Study (TRUCS) as having subsistence activity within the Project Area.

Employment and Income

The year-round economy of Southeast Alaska is largely dependent on the timber, recreation/tourism, and commercial fishing industries, which provide the majority of jobs. In the Ketchikan area, local residents earn their living through the forest products industry, the seafood harvesting and processing industry, and the recreation/tourism and supporting industries.

All have interests in how the forest will be managed. The study area vicinity is a mixture of town economic influences and remote lifestyles. Many of the area residents derive their incomes from economic activity in the towns and communities. At the same time, they value the areas for the recreational and aesthetic opportunities that are present in the vicinity. While the livelihood of some people may depend indirectly upon the forest, they also have an important stake in its management, both for short-term economic considerations and for the maintenance and fostering of their current lifestyles.

Transportation, communication, retail industries, educational, health and social services, and four levels of government (municipal, borough, State, and Federal) also contribute to the local economy. Ketchikan's single largest employer is the Ketchikan Pulp Company (KPC).

Timber Industry

Timber related employment is affected by technology and other factors that change over time. The employment multipliers used in this section represent past gains in efficiency. The employment and income estimates displayed in this section include the total effect throughout the economy associated with timber harvesting and processing. This total includes three separate components: direct effects, indirect effects, and induced effects.

Current timber harvest statistics for Southeast Alaska and the Tongass National Forest are provided in *Timber Supply and Demand 1990* (USFS R10-MB-156). This publication discusses the importance of primary manufacture laws prohibiting most round-log export from the Tongass and the direct effects it has on employment in Southeast Alaska. Of the 1.09 billion board feet of timber harvested in Southeast Alaska in 1990, about 43 percent was harvested from the Tongass National Forest and 56 percent from private lands. However, approximately 93 percent of the timber harvested on private lands was exported in the round.

Segments of the forest product industry which would be affected by the Upper Carroll Project Area includes dissolving pulp, logs, cants, dimension lumber, and wood chips.

Because most of Alaska's forest products are exported, fluctuations in timber markets are primarily a function of international markets and do not necessarily reflect domestic markets alone. In 1990, the timber industry provided almost 20 percent more employment than it did in 1980.

A constant supply of Tongass timber is not the only factor controlling timber employment. Other controlling factors include foreign exchange rates, the overall Pacific Rim demand for wood products, and competition among timber suppliers outside the Tongass National Forest. For instance, in 1994, the value of pulp increased over 50 percent due to a boll worm epidemic in China. The epidemic virtually wiped out China's cotton crop resulting in an increased demand for rayon which is made from wood pulp.

Commercial Fishing Industry

Harvesting and processing of fisheries resources provides a broad base of employment opportunities throughout Southeast Alaska. Many small towns and villages are very economically dependent on fish harvest and processing. The Ketchikan Area supports diverse fish-based employment opportunities for bottom fish, herring, shellfish, salmon, and other specialty products. The fishing industry is highly seasonal. The potential for year-round employment is enhanced with the diversity of harvestable species, harvest methodology (troll, seine, longline, trawl, etc.), and the processing methodology (frozen, canned, and the fresh market). Expansion of the bottom-fish sector provides the greatest opportunity for increased employment and more year round employment opportunities (Alaska Department of Labor, Research and Analysis 1990).

Recreation and Tourism

During the 1980s, the tourism industry became a major force in the economics of Southeast Alaska. Cruise ships traveled the Inside Passage making regular stops at Southeast Alaska ports in record numbers. Newer and larger capacity ships, as well as smaller ships tapping special interests are ushering in a new era of tourism to Southeast Alaska ports. The visitor season currently runs from May through September. Cruise ship passenger numbers visiting Ketchikan have grown from 85,000 passengers in 1981, to 378,645 in 1995. The economic impacts of this industry are likely to increase.

Marketing studies by the Alaska Division of Tourism indicate that scenery, forest, mountains, out-of-doors, and wilderness (unspoiled, rugged) were the top interests appealing to potential nonresident visitors (Bright 1985). While these interests account for nonresident increases, resident recreation also increased during the 1980s, as indicated by increased fishing and hunting license sales. The tourism and recreation industry affects many sectors of the economy which also serve the local residents and businesses. For example, retail trade, personal services, lodging, eating and drinking, and transportation sectors serve both visitors and local residents and businesses. The labor force employment associated with tourism and recreation are different from manufacturing industries because employment tends to be highly seasonal and low paying.

Sport Fishing

The *Southeast Alaska Sport Fishing Economic Study* (1991), a research report done for the State of Alaska, contains Ketchikan Area information:

"*In 1988, anglers spent $83.1 million for sport fishing in Southeast Alaska. Resident anglers spent about $40.7 million and nonresident anglers spent about $42.4 million. Ketchikan area resident anglers spent about $6.6 million on sport fishing. For nonresident anglers, sport fishing in the Ketchikan area generated the most spending, comprising about $13.7 million, or 32 percent of all nonresident angler spending.*"

Of all species sought by residents and nonresidents, king salmon generated the most spending, accounting for $13.3 million, or about 32 percent of all resident angler spending, and accounting for $9.6 million, or 23 percent of all nonresident spending. This has important significance for the local charter fleet.

It was estimated that in 1988, angler spending contributed toward the generation of $1.5 million in local sales tax revenue, $105,000 in lodging tax, $135,000 in state corporate income tax, and $1.2 million in fishing license revenues. For nonresident anglers, fisheries in the Ketchikan Area are the most valued throughout Southeast Alaska, with an annual "willingness-to-pay" value of $7.5 million. The willingness-to-pay concept can be described as a value which approximates market price.

Sport Hunting

The primary big game species in Southeast Alaska and the Ketchikan Area, in terms of number harvested and hunter participation, is the Sitka black-tailed deer. Deer constitute over 90 percent of the total big game harvest in Southeast Alaska (Doerr & Sigman 1986). Estimating value using the willingness-to-pay concept (the amount hunters are willing to pay to harvest a deer) places deer hunting by resident Southeast Alaskans at $332 (Swanson, Thomas, and Donnelly 1989). Hunting expenditures are not available for the Ketchikan area.

Employment and Income for Primary Zone of Influence

The Tongass timber program is part of a long-term cooperative effort among the Federal government, the State of Alaska, and local governments to provide greater economic diversity and stable employment opportunities in Southeast Alaska. The KPC Long-term Timber Sale Contract helped to guarantee the supply of raw materials necessary to attract new industry to Southeast Alaska at a time when the region's economic base was quickly eroding. Other forest resources, such as recreation, tourism, fishing, and hunting also contribute to local employment. The trade, service, and government sectors are the largest in terms of employment, total income, and payment of indirect taxes in both the Project Area and the Ketchikan area.

The following table displays the level of economic production, employee compensation, total income, and jobs derived from the major industry groups in the primary zone of influence.

Table Socio-Economic-1
Ketchikan Area Primary Influence Zone Input-Output Model Base Year Information (1985 dollars)

Industry	Total Industry Output (MM$)	Employee Compensation Income (MM$)	Total Place of Work Income (MM$)	Number of Jobs
Forestry & Fishing	$ 22	$ 4	$ 8	368
Construction	71	18	31	538
Manufacturing*	287	59	96	1,572
Transport., Comm. and Utilities	90	21	28	574
Wholesale and Retail Trade	56	26	32	822
Finance, Insurance and Property	59	9	39	464
Services	94	38	53	1,617
Government and Special Industry	78	58	62	1,880
Total	**$757**	**$233**	**$349**	**7,835**

SOURCE : Project Planning Record

* Includes logging, sawmills, and pulp mills

Returns to the Federal Treasury

Management of the national forests generates revenues for the Federal Treasury. Some uses of Tongass National Forest land and resources generate income which is paid to the Federal government. Returns from the Tongass National Forest fluctuate from year to year. Returns were $45 million in 1987 and $34 million in 1994. Timber sales are the source of about 99 percent of Federal receipts for this area. While revenue from timber sales dominates the returns, fees from recreation permits, admissions, and user fees make a contribution as well.

Payments to State

Revenue from National Forest timber sales are shared with state and local governments. Twenty-five percent of the total revenues received by the national forests are returned to State and local governments to support schools and roads (see Table Socio-Economic-3). A percentage of all monies received (including purchaser road credits) from the Ketchikan Administrative Area is paid to the State of Alaska. Payments to the State ranged from $3.2 million in 1992, to $8.7 million in 1994, with $388,314 going to the Ketchikan Gateway Borough. Changes in these payments are of considerable interest to local residents.

Economic Efficiency

The harvesting of timber involves large investments. The economic efficiency of these investments is relevant to the choice among environmentally different alternatives being considered. This issue is addressed in three ways. First, the economic efficiency of alternatives will be evaluated. Historic costs for managing, harvesting, and processing timber, and historic prices for various timber and wood products are identified and the present net value (PNV) of each alternative is estimated. Second, below cost timber sales will be evaluated. Third, other non-market and nonpriced issues are evaluated and discussed. Many of these issues are nonquantifiable within the scope of this project and, therefore, are assessed in a qualitative way. For a comprehensive analysis, these factors must be considered along with the timber economics to determine the net benefit to the government from timber harvest.

The National Forest Management Act of 1976 (NFMA) set requirements for economic efficiency of forest management proposals. Although the Forest Service has generally tried to achieve cost-effective management (lowest possible input cost per unit of output), systematic evaluation of all costs and benefits from forest management practices and activities has been undertaken only in recent years.

The measure of economic efficiency applied in formulating and evaluating alternatives is Public Net Benefits (36 CFR 219.1(a) and 219.12(f)). Public Net Benefits (PNB) are the sum of PNV and non-priced commodity values. Examples of non-priced benefits include scenic quality, wildlife habitat, and community stability. PNV is a method of adjusting revenues and costs to allow their comparison over time. Values of some non-priced commodities are inferred from observations such as the number of participants, tolerance of congestion, and expense of participation.

Sales Below Cost

In response to concerns about the costs and revenues from timber sales on National Forest lands, especially sales where costs exceeded revenues, the General Accounting Office (GAO) and the Forest Service, at the direction of Congress, jointly developed the Timber Sale Program Information Reporting System (TSPIRS). TSPIRS reports are designed to describe financial and economic aspects of the forest-wide timber sale program. Managing timber is a long-term commitment of land and resources with a variety of activities occurring each year on stands at various ages in their rotation. For this reason, many forest management costs, such as roads and reforestation, are pooled and then redistributed over a series of years based on the amount of timber harvested. This is a different approach than is used in the calculation of PNV described above where costs are measured in the year they occur and discounted back to the present.

Large development costs usually accompany new timber sales. These costs in turn translate into revenue for local businesses and employment and income for local people. The TSPIRS reports provide a description of the extent of investments in timber harvesting on the Tongass National Forest. In 1994, the Tongass National Forest had expenses exceed revenues in excess of $0.3 million. Revenues were over $123 per MBF while total controllable expenses were about $124 per MBF (includes payments to the State of $4.83 per MBF). There was a total net gain of about -$1.10 per MBF (Page 60, 1994 TSPIRS Report).

Non-market Values

A discussion of the relationship between an economic benefit to cost analysis and the analysis of unquantified environmental effects, values, and amenities is useful in considering project alternatives. In Forest Service terminology, three types of values are typically considered in economic evaluations: market values, non-market values, and non-priced values. Market values are those established through a market, such as timber. Non-market values are those that can be quantified using economic techniques that infer or deduce values which might prevail if a market were present, such as some types of recreation. These first two types are included directly in the benefit to cost analysis. Non-priced values refer to those for which it is impossible to quantify a value, even with non-market economic techniques such as the value of religious sites or genetic diversity.

Recreation, fish, and wildlife values are not typically established by a market but are important considerations in making resource management decisions. Wildlife viewing and photography are some of the most popular activities among forest visitors. A survey of businesses which provide products and services for wildlife viewing, wildlife photography, and other nonconsumptive wildlife uses indicated that this use is rapidly increasing in Southeast Alaska (Shea 1990). It is estimated that over 200 businesses in Southeast Alaska provide wildlife viewing recreation services. This business activity is growing as much as 33 percent annually, with client expenditures contributing substantially to the economy (Shea 1990).

Non-priced Values

Non-market values can be applied to changes in the levels of some recreation, fishing, and hunting activities associated with the alternatives to estimate the economic value of these changes. These values can then be incorporated into a benefit to cost analysis and a below-cost sales analysis. There are many other values, called non-priced values, that people hold for which markets do not exist and to which market values cannot be attached. Among others, these include active use values (subsistence), the value of the forest as habitat for wildlife, and passive use values. Passive use values include existence, option, and other non-use values (Mitchell and Carson 1989).

Some important non-priced values are visual quality, diversity and quality of recreation opportunities, old-growth retention, suitable habitat for threatened and endangered species, and cultural resources. Another is the value of retaining old-growth forest and wilderness or semi-wilderness areas. This represents the value that people who will never visit the Project Area receive from the knowledge that the area exists and the condition (or perceived condition) in which it exists. This value can be inter-generational since timber cuts conducted in the 1990s, will be visible for one human generation. Recent work in this field was conducted following the Exxon Valdez oil spill in Prince William Sound, Alaska. Quantitative studies were conducted to determine prices for values and were based on people's willingness-to-pay to avoid habitat degradation. Such surveys, which must be conducted on a national or international basis, are beyond the scope of this project and have not been conducted for the Tongass as a whole. It should be noted that contingent values can be quite high. Those arrived at for the oil spill study determined that the people of the United States were willing to pay about $3 billion to avoid the oil spill (Carson et al. 1992). It is evident that similar values exist for the Tongass because of the concern expressed by some conservation and preservation organizations about logging on the Tongass and the reaction to these pressures by Congress.

Judgments are necessary in assessing whether benefits of maintaining non-priced values equal or exceed the trade-offs of producing priced values. While the quantitative dollar values of each cannot be determined, they generally can be examined by association with such quantitative indicators as acres, resource inventories, or timber production related activities and outputs.

Effects of the Alternatives

Employment and Income

Timber Industry

Each alternative will affect the number and composition of timber-related employment within the communities in the primary zone of influence which is the Ketchikan region.

In estimating employment impacts it is assumed that other supply and demand factors affecting markets for forest products and uses remain constant; however, assumptions lose validity as time frames are extended. For example, the amount of timber offered for sale within the Project Area is not the only factor that affects the number of wood products industry jobs. Other factors include the supply and demand for wood products and the subsequent number of employment opportunities, worker productivity, interest rates, import and export levels, production and shipping costs, competition, and other landowner harvest levels and policies.

Employment and Income Levels

Multipliers generated by the Forest Service's economic model, IMPLAN, were used to provide estimates of employment and income levels which would be supported by each of the proposed timber harvest alternatives within the Upper Carroll Project Area.

The economic effect of any alternative is composed of primary or direct effects, and secondary or indirect and induced effects. Direct effects are measured primarily as increases in employment and income within the wood products industry (including harvesting, construction, logging transportation, processing, and sawmill operations) resulting from any changes in production levels. This model is based on the assumption that any increase in production is in response to an increase in market demand. Indirect and induced effects, here on to be referred to as indirect effects, are an economic by-product of increased expenditures (increased demand) for goods and services on the part of industries directly involved in timber harvesting, as well as the additional wage earners employed in timber harvesting and production. For example, sawmills require electricity, mechanical components, and miscellaneous supplies to meet the demand for lumber. Some of these necessities will be purchased locally. The providers of those services and supplies will, in turn, increase their consumption of goods and services, thus creating additional rounds of expenditures. Further economic stimulus is created when wages from the direct and indirect employment effects are spent within the project region. Multipliers generated by IMPLAN capture all rounds of spending and response generated through increases in industrial and individual consumption. Table Socio-Economic-2 displays the results derived from the IMPLAN model analysis for each alternative.

Table Socio-Economic-2
Projected Timber-related Employment and Income Effects by Alternative*

	Alt. 1		Alt. 2***		Alt. 3		Alt. 5		Alt. 6		Alt. 7	
Timber Harvest	**Jobs**	**$$**	**Jobs***	**$$****	**Jobs**	**$$**	**Jobs**	**$$**	**Jobs**	**$$**	**Jobs**	**$$**
Logging	0	0	162	$6.17	88	$3.35	135	$5.14	86	$3.27	49	$1.87
Construction	0	0	70	2.67	38	1.45	58	2.21	37	1.41	21	0.79
Marine Transport	0	0	3	0.11	2	0.08	2	0.08	1	0.04	1	0.04
Subtotals	0	0	235	8.95	128	4.87	195	7.43	124	4.72	71	2.70
Timber Process												
Sawmills	0	0	95	3.61	52	1.98	79	3.01	50	1.90	29	1.10
Pulp mills	0	0	147	5.60	81	3.08	123	4.68	78	2.97	44	1.68
Subtotals	0	0	242	9.21	133	5.06	202	7.69	128	4.87	73	2.78
Totals	**0**	**0**	**477**	**18.16**	**261**	**9.94**	**397**	**15.12**	**252**	**9.59**	**144**	**5.48**

SOURCE: Marks 1996

* Employment = Direct Employment (person years)
** Income = Direct Income ($ million)
*** Number of jobs and income is calculated by alternative volume estimates only. Calculations include ROW volume

Alternative 1 proposes no timber harvest and could result in a decline in timber-related employment should the mill not be able to substitute volume from another source. The effects of Alternative 1 are not predictable and could range from elimination of shifts to a partial or even a full short-term shutdown in addition to the potential loss of revenue.

Possible long-term ramifications of Alternative 1 could be the destabilization of the wood products industry in the affected community. This assumes that no other replacement timber harvest projects are cleared through the NEPA process for offer beyond 1996.

Employment opportunities closely parallel the level of timber harvest. A larger timber harvest is accompanied by greater local expenditures. Therefore, Alternative 2 produces the highest impacts, since local expenditures associated with its implementation are highest among the alternatives. The annual harvest and annual mill production under Alternative 2 would result in the largest employment gains associated with the harvest; harvest under the scenarios proposed for Alternatives 3 and 5 would sustain a lower level of regional employment relative to Alternative 2. As employment is reduced, regional income and economic output would fall as well.

Long-term impacts on timber employment on the Ketchikan Administrative Area are a function of the Forest Plan, and the analysis in the TLMP RSDEIS (1996a) is incorporated by reference. The primary effect of any of the action alternatives would however be maintenance of current employment levels.

Commercial Fishing Industry

Current standards and guidelines and management area prescriptions are expected to limit measurable effects on fish during timber harvest and related activities. There are no substantive changes in commercial fish habitat capability predicted. The direct and indirect jobs attributable to National Forest System lands for the commercial salmon industry should also remain unchanged for all alternatives.

Neets Bay Fish Hatchery (SSRAA)

No substantive effects have been predicted due to timber harvest on the water resources supplying the Neets Bay Fish Hatchery (see Water Resources Section). Alternative 2 provides for timber harvest in the Neets Bay area and would provide a road connection to the LTF at Shrimp Bay. No economic benefits are predicted if the road connection to Shrimp Bay is built.

Recreation and Tourism

Projections for future employment for Southeast Alaska in the recreation and tourism industries, including employment related to sport hunting and fishing, are a 27 percent increase in use for recreation and tourism, 36 percent for sport fishing, and 53 percent for hunting related jobs during the 1990s (TLMP RSDEIS, 1996a). The core community of Ketchikan should on the average reflect these increases. Differences between action alternatives should have little overall impact on these projections.

The action alternatives will have no measurable effects on sport fishing jobs. The action alternatives are expected to have no measurable effects on jobs generated by permits for kayak or air charter services due to set standards and guidelines for visual resources. There are no outfitter/guides with current permits or waivers operating within the Upper Carroll Project Area.

Access to the area by plane will remain unchanged. However, access by foot travel and ATVs will increase with implementation of action alternatives. Past experience in adjacent project areas show an increase in sport fishing and hunting due to having a developed LTF and docking facility with a connecting road system. Even though roads are often closed to vehicle traffic, hunters will often boat to LTFs and gain access to a project area by utilizing the road system. ATVs are often used if main roads remain open.

Returns to the Federal Treasury

A TSPIRS analysis depicting Federal returns for the Upper Carroll DEIS was considered but not performed. TSPIRS was designed to be assessed on an annual basis at the National Forest level for the timber program as a whole, with expenses and costs amortized over the length of the entire rotation (100 years). Furthermore, TSPIRS sums all expenses associated with a timber sale including NEPA prep work, timber inventories, etc. These expenses are then put into a sale or growth activity pool and a percentage is subtracted each year based on how much volume is harvested versus how much remains under contract. Tracking annual Project expenses from planning through implementation and final harvest spans several years and is difficult to track on a project-by-project basis (R. Zaborske, Regional Office Direction, 1993). The estimated costs and profits analysis under Economic Efficiency within this section more accurately portrays actual returns to the Federal Treasury.

Payments to the State

When National Forest Receipt Act payments change, the borough must compensate with other sources of revenues to maintain the same quality and quantity of school and road programs. These monies are not always at a stable level and are not 100 percent predictable for use in a budgeting process. Fluctuations have occurred in the past.

Table Socio-Economic-3 displays the estimated volume harvested, anticipated total timber receipts (including Purchaser Credits for road construction), as well as estimated returns to the State and Borough, and total estimated net revenue to the United States Government. These estimated returns could be spread out over a 3 to 7 year period depending on the rate of harvest. The anticipated total timber receipts for Alternative 2 is displayed both with and without the Shelter Cove road tie which would utilize the Shelter Cove LTF or the preferred (reconstruction of an existing LTF site) LTF site between Swan Lake and the Carroll River.

Table Socio-Economic-3
Estimated Returns to State of Alaska and Ketchikan Gateway Borough

Alt.	Estimated Total Volume (MMBF)*	Estimated Total Receipts (M$)**	Estimated Returns to State (M$)***	Estimated Returns to KGB (M$) **
1	0	0	0	0
2 SC	64.352	13.273	3.318	.149
2 W/O	64.352	14.104	3.526	.159
3	34.262	8.110	2.028	.091
5	52.808	11.660	2.915	.131
6	33.094	7.033	1.758	.079
7	18.518	.710	.118	.008

SOURCE: Marks 1995

* Rounded to the nearest MBF including right-of-way.
** Based on mid-market rates, timber receipts, and purchaser credits for road construction.
*** For/from this action only.
SC Includes Shelter Cove LTF Road Tie only.
W/O No Road Tie, Use Upper Carroll preferred (existing) LTF only.
Note: M$=millions of dollars

Economic Efficiency

Historically, the timber market has been cyclic, with sharp peaks and valleys in pond log values. A modest change of a few dollars per thousand board feet can result in significant shifts in the economic supply of timber. The present net value yardstick reflects historical average conditions for both prices and costs, and may not represent the economic viability of the Project Area in any given year. In considering project break even values, project pond log values that would be necessary for the discounted benefits to equal discounted costs are shown in Table Socio-Economic-4. These values would fall roughly into the top one-fourth to one-third of historical prices for Tongass National Forest timber.

Break Even Pond Log Values

Break even values are shown for Alternative 2 both with and without the proposed road tie to the Shelter Cove LTF. Both values are displayed due to the large difference in construction costs which greatly influence the alternative economics. Also shown are break even values for the Upper Carroll Project Area preferred LTF site (reconstruction of an existing LTF site) versus values for constructing a new LTF site with a connecting road further south of the existing site (see Alternative Maps).

Table Socio-Economic-4
Estimated Break Even Pond Log Values from Mid-market Analysis

	Alternatives					
Pond Log Values ($/MBF)	**Alt. 2 SC**	**Alt. 2 W/O**	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Preferred LTF*	697.88	591.43	519.12	592.59	548.82	556.56
South LTF**	697.88	596.83	529.26	599.17	559.34	575.33
Neets Bay Only***		841.89		723.95		

* Preferred LTF site which reconstructs existing LTF site
** LTF site located south of preferred site-requires new road construction and new site development
*** Uses Shrimp Bay LTF in Alt.2, Uses Neets Bay water drop in Alt. 5.
Alt. 2 SC - Alt. 2 with Shelter Cove LTF road tie.
Alt. 2 W/O - Alt. 2 without Shelter Cove LTF road tie; utilizes Preferred LTF or South LTF site.
SOURCE: Marks, 1995.

Neets Bay and Vicinity

Neets Bay only break even values were calculated for Alternatives 2 and 5 to display the higher than average direct costs associated with timber harvest. These high direct costs for both Alternatives are due to: 1) higher than average unit elevations and limited access leading to longer yarding distances, 2) flight path adjustments around existing SSRAA facilities which also lead to longer yarding distances, 3) additional costs associated with landing logs on a barge located in Neets Bay (Alternative 5 only), 4) higher than average road building costs of 18.01 miles of new road to access seven cable units and four helicopter units (Alternative 2 only), and 5) above average transportation costs (haul) which also include additional tow costs from the Shrimp Bay LTF (Alternative 2 only).

Mid-market Analysis

Table Socio-Economic-5 summarizes the differences in PNV between alternatives. The PNV represents the economic efficiency of each alternative or the difference between discounted benefits and discounted costs. Each alternative has a specific management strategy or emphasis which requires certain timber harvest levels that may not be the most economically efficient harvest pattern for the Project Area. The management strategy for Alternative 3 is for maximum economic efficiency. The mid-market analysis for all action alternatives show a positive net stumpage value for Alternative 3 and negative net stumpage values for Alternatives 2 (with and without the Shelter Cove road tie), 5, 6, and 7. Negative net stumpage values indicate that the discounted direct costs associated with timber harvest exceeded the discounted direct value of the benefits. Further analysis for all action alternatives include calculating the direct costs associated with 1) reconstruction of the preferred (existing) LTF site and 2) the direct costs associated with construction of a new LTF with connecting road further south. These costs are displayed to show their affect on net stumpage values for all alternatives (excluding Alternative 2 with the Shelter Cove road tie).

Table Socio-Economic-5
Summary of Estimated Costs and Profits by Alternative Mid-market Analysis

Economic Appraisal Inputs	Alt. 1	Alt. 2SC*	Alt. 2W/O**	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Total Volume $(MBF)_6$	0	64,352	64,352	34,262	52,808	33,094	18,518
Roads, New and Repair (Miles)	0	78.7	71.7	32.2	57.9	28.2	4.2
Pond Log Value $(\$/MBF)_1$	0	539.48	539.48	534.94	538.95	540.18	539.13
Stump to Truck Costs $(\$/MBF)_2$	0	185.65	185.65	155.35	189.79	195.33	386.95
Transportation Costs $(\$/MBF)_2$	0	67.84	50.13	53.35	41.10	46.09	33.08
Administration Costs ($/MBF)	0	10.48	10.48	10.48	10.48	10.48	10.48
Temporary Development Costs $(\$/MBF)_2$	0	18.64	18.64	21.46	21.23	17.24	2.73
Upper Carroll LTF No. 7 Reconstruction (Preferred) Option	**Alt. 1**	**Alt. 2SC***	**Alt. 2W/O****	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Road Development Costs $(\$/MBF)_2$	0	364.67	270.80	228.10	274.45	221.16	55.78
Total Harvest Costs ($/MBF)	0	647.29	535.71	458.01	537.04	490.30	489.01
Conversion $(\$/MBF)_3$	0	-107.81	+3.77	+76.93	+1.91	+49.88	+50.11
60% Normal Profit and Risk $(\$/MBF)_4$	0	50.24	55.72	95.99	55.55	58.52	67.54
Net Stumpage Value $(\$MBF)_5$	0	-158.40	-51.95	+19.06	-53.64	-8.64	-17.43
Upper Carroll Site No. 8 New Construction	**Alt. 1**	**Alt. 2SC***	**Alt. 2W/O****	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Road Development Costs $(\$/MBF)_2$	0	0	276.52	239.17	281.41	232.28	75.63
Total Harvest Costs ($/MBF)	0	0	541.43	469.08	544.00	501.42	508.86
Conversion $(\$/MBF)_3$	0	0	-1.95	+65.86	-5.05	+38.76	+30.26
60% Normal Profit and Risk $(\$/MBF)_4$	0	0	55.40	57.26	55.17	57.92	66.46
Net Stumpage Value $(\$MBF)_5$	0	0	-57.35	+8.60	-60.22	-19.16	-36.20

SOURCE: Marks 1996

* With Shelter Cove to Carroll Inlet road tie (no LTF required).
** Without Shelter Cove to Carroll Inlet road tie.
1 Pond log values from Table Timber-12
2 Costs from Timber Appraisal Spreadsheet
3 Conversion = pond log value - total harvest costs
4 Based on published 1/92 values adjusted to 3rd quarter of 1994
5 Net stumpage = conversion - 60 percent normal profit and risk
6 Volume includes ROW.
Values are meant for comparative purposes only
All transportation costs include all costs not associated with capital investments or costs normally connected to road construction, such as: fall, buck, yard, sort, load, haul, dump, raft, and tow.
All construction costs include costs associated with LTF development, road construction, and reconstruction, such as: pit development, clearing, grubbing, embankment, haul, excavation, and related material, such as bulkheads, bridges, and culverts.

Current-market Analysis

The market fluctuation between the mid-market analysis (NOI-August 1994) and the current-market analysis (May 1996) is an approximate overall increase of 7 percent in pond log values. However, the overall increase in pond log value is decreased by higher overall logging costs of approximately 4 percent. This overall net increase in pond log value results in all alternatives showing a net gain indicating that all discounted direct costs associated with timber harvest were less than the discounted direct value of the benefits (pond log value). As in the mid-market analysis, direct costs associated with reconstruction of the preferred (existing) LTF site and the construction of a new LTF with connecting road are displayed to show their affect on net stumpage values for all alternatives (excluding Alternative 2 with the Shelter Cove road tie).

Table Socio-Economic-6
Summary of Estimated Costs and Profits by Alternative Current-market Analysis

Economic Appraisal Inputs	**Alt. 1**	**Alt. 2SC***	**Alt. 2W/O****	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Total Volume (MBF)6	0	64532	64532	34262	52808	33094	18518
Roads, New and Repair (Miles)	0	78.7	71.7	32.2	57.9	28.2	4.2
Pond Log Value ($/MBF)1	0	585.00	585.00	587.84	578.34	576.58	571.91
Stump to Truck Costs ($/MBF)2	0	192.04	192.04	163.04	196.00	200.70	386.81
Transportation Costs ($/MBF)2	0	70.59	47.52	37.35	38.48	43.48	32.05
Administration Costs ($/MBF)	0	20.14	20.14	20.14	20.14	20.14	20.14
Temporary Development Costs ($/MBF)2	0	18.63	18.63	21.46	21.20	17.23	2.72
Upper Carroll LTF No. 7 Reconstruction (Preferred) Option	**Alt. 1**	**Alt. 2SC***	**Alt. 2W/O****	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Road Development Costs ($/MBF)2	0	364.37	270.57	228.10	274.16	220.94	55.72
Total Harvest Costs ($/MBF)	0	665.78	548.91	472.79	549.98	502.49	497.43
Conversion ($/MBF)3	0	-80.77	+36.10	+115.05	+28.36	+74.09	+74.47
60% Normal Profit and Risk ($/MBF)4	0	56.65	61.76	64.00	61.86	64.83	74.04
Net Stumpage Value ($MBF)5	0	-137.42	-25.66	+51.05	-33.50	+9.26	+0.43
Upper Carroll Site No. 8 New Construction	**Alt. 1**	**Alt. 2SC***	**Alt. 2W/O****	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
Road Development Costs ($/MBF)2	0	0	276.29	239.17	281.12	232.05	75.54
Total Harvest Costs ($/MBF)	0	0	554.63	483.86	556.94	513.60	517.25
Conversion ($/MBF)3	0	0	+30.38	+103.98	+21.40	+62.98	+54.65
60% Normal Profit and Risk ($/MBF)4	0	0	61.45	63.39	61.48	64.22	72.96
Net Stumpage Value ($MBF)5	0	0	-31.07	+40.59	-40.08	-1.24	-18.31

SOURCE: Marks 1995

* With Shelter Cove to Carroll Inlet road tie (no LTF required).
** Without Shelter Cove to Carroll Inlet road tie.
1 Pond log values from Table Timber-12
2 Costs from Timber Appraisal Spreadsheet
3 Conversion = pond log value - total harvest costs
4 Based on published 1/92 values adjusted to 4th quarter of 1995
5 Net stumpage = conversion - 60% normal profit and risk
6 Volume includes ROW.
Values are meant for comparative purposes only
All transportation costs include all costs not associated with capital investments or costs normally connected to road construction, such as: fall, buck, yard, sort, load, haul, dump, raft, and tow.
All construction costs include costs associated with LTF development, road construction, and reconstruction, such as: pit development, clearing, grubbing, embankment, haul, excavation, and related material, such as bulkheads, bridges, and culverts.

Alternative 3 has the most potential for profit due to being the most economically efficient with the least amount of road to build versus number of harvest units accessed. Alternatives 5 and 6 have consecutively more road to build to access increasingly more difficult and isolated harvest units, as well as more expensive helicopter yarding. They also show a decreasing potential for profit. Alternative 7 has the least amount of road costs (reconstruction of existing roads only), but the high cost of helicopter yarding offsets the cost savings of road construction, thereby reducing the economic efficiency of the alternative. Alternative 2 (both with and without the Shelter Cove road tie) shows the least potential for profit due to having the most amount of road to build to access a large number of difficult and isolated harvest units. The calculated net stumpages are indicative of comparative profitability rather than the magnitude of potential profitability.

Sales Below Cost

Alternative 3 shows a net gain to the federal government using the mid-market analysis (see Economic Efficiency Section Table Socio-Economic-5). Alternatives 2 (with and without the Shelter Cove road tie), 5, 6, and 7 show a net loss to the federal government. The current-market analysis shows a net gain for Alternative 3, for both LTF options, and for Alternatives 6 and 7, for reconstruction of existing LTF option only. All other alternatives and LTF options showed a net loss to the federal government. Future market price fluctuations, costs of selling and harvesting timber, and changes in general administrative costs per volume harvested could have different results than these estimates.

Non-timber Harvest Values

Neither the PNV nor TSPIRS accounting conventions consider non-timber harvest values. Land uses that result in decreased visitations or in a change from higher-valued to lower-valued visitor use will result in a net loss to society. Likewise, any activities which decrease societies willingness-to-pay for the area result in a loss.

It is not possible to quantitatively compare these priced and non-priced values. Non-priced or non-market values resulting from the proposed action could result in losses due to decreases in "nature" tourism and decreases in societal willingness-to-pay for post-logged landscapes. Due to the limited access of the Project Area, this loss is expected to be proportional to the amount of access gained by implementing an action alternative. However, this loss is expected to be minimal. Benefits or gains would be realized from employment and profits, government revenues, increased access in the Project Area, and other factors discussed in this impact statement. Methods of accounting differ between TSPIRS and PNV, the difference being that road costs are charged over an extended time period (PNV) instead of at time of construction (TSPIRS). Depending on which accounting method is used in combination with expected non-priced factors could make the difference between a net gain or a net loss.

Of the action alternatives, Alternative 2 harvests the most seen acreage and may create the greatest visual impact to the nonconsumptive user. Alternative 3 harvests the least seen acreage and could have the least amount of visual impact.

Cumulative Effects

The cumulative effects of each of the alternatives on the economic and social environment are quite difficult to estimate. There are a wide variety of factors affecting the employment, income, receipts, population, lifestyle, and community stability of Southeast Alaska. While it is not easy to project the incremental effects of the proposed actions on the Project Area, there are two facets of long-term timber harvest in the Project Area that can be addressed.

First, from the standpoint of employment, personal income, population, community services, and community stability, there is substantial benefit to maintaining long-term timber harvest levels. The receipts generated, including revenue to the U.S. Treasury, payments to the State of Alaska, taxes, and dollars brought into the community, all represent an economic benefit of continued timber harvest activity. The TLMP RSDEIS (1996a) schedules areas for long-term timber harvest activity. The Upper Carroll Project Area is one of the areas scheduled to meet these economic and social needs.

The second facet of a long-term timber harvest that can be addressed is the alteration of the natural environment that takes place when roads are constructed and timber is harvested. Some of the economic and social value of Southeast Alaska is dependent on its natural setting. The recreation and tourism industry is based primarily on the natural conditions and scenic quality. As more and more acres of National Forest System lands and other lands are converted from a natural condition to a managed forest, the activities dependent on and the values attributed to the natural state of the forested land will be affected.

The balance necessary to maintain a viable or even robust economic and social environment is set at a National Forest level, not at a project level. Based on regional standards and guidelines, the action alternatives have been constructed to minimize the negative cumulative effects on the economics and community values of the affected communities when considering the total resource. Cumulative effects on employment are best displayed in the TLMP RSDEIS (1996a), Preferred Alternative. This analysis indicates that for the Ketchikan area as a whole, National Forest System-based timber employment and commercial fishing employment will remain fairly constant, while recreation and tourism employment will increase in the future. Harvesting in the Upper Carroll Project Area is included as part of the overall harvest level assumed as a basis for this projection.

One consequence of timber harvests at the level projected by the Forest Plan is the degree of continued stability of communities dependent on timber from the Project Area. The analysis conducted for this project suggests that the timber supply in the Project Area could be reduced following the next several entries (see the Silviculture, Timber, and Vegetation Cumulative Effects section). To the extent that this is correct, timber-dependent communities would suffer losses which would vary by their degree of dependency on the timber industry. This would result in some community residents finding employment in other timber producing geographic areas.

Community Stability

Timber harvest is one of a variety of ways of maintaining community stability. Value-added opportunities, such as the further processing of wood products (the manufacture and export of plywood, medium density fiberboard, speciality cedar siding and roof shakes, etc.) could be used to supplement community employment in association with expanding existing natural resource-based industries such as tourism and sport fishing.

The analysis conducted for this project suggests that the timber supply in the Project Area could be reduced following the next several entries (see the Silviculture, Timber, and Vegetation Cumulative Effects section). As the mature timber resource base is harvested, and yearly harvests decrease in volume, it is probable that fewer workers would be required for timber harvest and transport to the Upper Carroll area. This reduction in local work force could result in a decreased population within logging communities currently living in and adjacent to the primary zone of influence of Ketchikan. Alternately, more workers might increase their commuting distances or change employment patterns such as living part time at work camps. Decreasing timber volumes or the halting of harvests from the Project Area in certain years could also result in a reduced labor force at local and regional processing facilities, other support facilities, and could have ripple effects throughout the regional economy.

Mitigation

Mitigation measures could be undertaken to improve net national benefits from the Project Area. This project addresses only timber investment opportunities. Alternatives 2, 5, 6, and 7 show a negative PNV based on the mid market analysis, while Alternative 3 shows a positive PNV. Other natural resource investment opportunities may offer better investment choices and at the same time contribute to mitigating potential community stability goals.

Monitoring

A monitoring plan has been developed for the Tongass National Forest by the Forest Planning Team and is described in the proposed Forest Plan (1991). The Forest Plan contains no specific monitoring goals for socio-economic resources.

Project-specific monitoring that is unique to the Upper Carroll Project Area has been identified for several resources. Project-specific monitoring is not identified for socio-economic resources in the Upper Carroll Project Area.

Subsistence

Key Terms

Alaska National Interest Lands Conservation Act (ANILCA)—requires evaluations of subsistence impacts before changing the use of certain Federal lands.
Non-rural—generally a community with more than 7,000 people; does not qualify for priority use of subsistence resources.
Rural—any area of Alaska determined by the Federal Subsistence Board to qualify as such; qualifies for priority use of subsistence resources.
Subsistence—customary and traditional uses by rural Alaskans of wild renewable resources.
Wildlife Analysis Area (WAA)—a division of land designated by Alaska Department of Fish and Game (ADF&G) and used by the USDA Forest Service for wildlife analysis.

Affected Environment

Many Southeast communities use natural resources as a base or supplement to their livelihoods. Nearly a third of rural households in Southeast Alaska get at least half their meat and fish by hunting and fishing (Holleman and Kruse 1991). Fish and game are widely preferred sources of food among Southeast households, regardless of their incomes. Examples of major subsistence resources include deer, salmon, halibut, trout, harbor seal, crab, clams, waterfowl, and berries. Findings from the TRUCS indicate that "members of the highest income group have the highest mean harvest and the lowest mean percent of meat derived from subsistence activities" (Kruse and Muth 1990).

Subsistence activities represent a major focus of life for rural residents. These resource or subsistence gathering activities include hunting for deer, bear, marine mammals, and birds; digging clams; catching fish and shellfish (crabs, shrimp); harvesting marine invertebrates; trapping furbearers; collecting firewood; collecting herring eggs; and collecting berries and edible plants and roots. Subsistence goods may be eaten, traded, given away, or made into an item of use or decoration. For example, the fur from the marten or sea otter may be used for regalia costumes which are used in ceremony and dance.

Even for households which can afford to purchase all their own food, the act of gathering subsistence resources is an important cultural aspect reflecting deeply held attitudes, values, and beliefs. Some traditional foods are not available through any other means than subsistence, and often, the occasions for gathering wild foods and edible plants are social events. Historical patterns of movement such as the annual cycle of dispersal into small family groups at summer fishing camps and then to larger gatherings at protected winter villages are also linked to the tradition of subsistence gathering.

Average per capita income may or may not indicate the importance of subsistence to a community. While individuals of low income may have a greater dependence on subsistence gathering, individuals with a higher income may simply be in a position to have a more comfortable lifestyle because they combine their subsistence activities with their ability to purchase goods. Higher income does not deter an individual from gathering resources and sharing those with friends and family (Kruse and Muth 1990).

Sharing of subsistence resources is important not only between households within communities, but also with extended families and friends in other areas. This includes sharing with those households which are unable to participate in the harvest of resources. And, because some communities have access to resources not found in other communities, sharing of subsistence resources occurs between as well as within communities.

The importance of subsistence is recognized in both State and Federal laws. With the passage of the Alaska National Interest Lands Conservation Act (ANILCA), Congress recognized the importance of subsistence resource gathering to the rural communities of Alaska. ANILCA (16 USC 3113) defines subsistence as:

> "*The customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade.*"

ANILCA finds and declares that "*the continuation of the opportunity for subsistence uses by rural residents of Alaska, including both Natives and non-Natives, on public lands.*" It also declared that "*...consistent with sound management principles, and the conservation of health populations of fish and wildlife, the utilization of the public lands in Alaska is to cause the least adverse impact possible on rural residents who depend upon subsistence uses of the resources of such lands.*"

Effective July 1, 1990, the Federal government became responsible for the management of ANILCA Title VIII subsistence use of fish and wildlife resources on Federal public lands. Regulated by the Federal Subsistence Board, the taking of fish and wildlife on public lands for subsistence uses is restricted to Alaska residents of rural areas or rural communities. Non-rural residents are not provided a preference for the taking of fish and wildlife on public lands. In Southeast Alaska, Juneau and Ketchikan have been determined to be non-rural by the Federal Subsistence Board.

In 1988, a detailed subsistence resource and use inventory of the Tongass National Forest was started as part of the TLMP Revision process. The *Tongass Resource Use Cooperative Study* (TRUCS) of 1988, was conducted by the University of Alaska's Institute of Social and Economic Research in conjunction with the U.S. Forest Service and the Division of Subsistence of the ADF&G (Kruse and Frazier 1988).

In the TRUCS, researchers went to over 30 communities in Southeast Alaska and conducted interviews with randomly selected households about their 1987 subsistence uses. As part of the interview, household residents were also asked to draw special maps of the areas used for hunting and fishing. As stated by Kruse and Frazier in the TRUCS (1988) it should be noted that all figures used in reporting subsistence are based on a sample of households. Therefore, it is entirely possible that actual amounts harvested were either higher or lower than reported by sample households. A detailed description of the survey is found in the *Tongass Resource Use Cooperative Survey Technical Report Number One* from the Institute of Social and Economic Research, University of Alaska.

Goldschmidt and Haas (1946) identified the land-use patterns associated with Native communities that existed in the mid-twentieth century in Southeast Alaska (map of these areas is displayed in the Cultural Resources section). Comparing these maps with information from the 1987 TRUCS maps and ADF&G Subsistence Division maps, it appears that hunting and fishing use by Natives in Southeast Alaska is still tied to some extent to historic traditions of who may hunt and fish on which lands. Despite the introduction of technological innovations (such as large, modern boats) that would allow residents of Native communities to range much greater distances than in earlier periods, their use appears to be concentrated in locations generally conforming to traditional clan land ownership boundaries. The distribution of harvest locations for non-Native communities, on the other hand, will often range over greater areas.

Subsistence is a complex issue covering many aspects of lifestyles which are embodied in the people who reside in Alaska. In striving to be sensitive to the subsistence needs of the users of the Upper Carroll Project Area, the Forest Service used data collected in TRUCS (Kruse and Frazier 1988) and ADF&G deer harvest survey statistics to identify communities that use the Project Area. Based on the "Areas Ever Used for Deer Hunting by Southeast Alaska Subsistence Households" (TLMP 1991a), the Project Area receives light use (1-10 households) except for the beach fringe areas which are used by 11-50 households. This is less use then areas like Prince of Wales Island that is used by more than 100 households.

A limited amount of subsistence information about the Carroll River area was gathered as part of the subsistence analysis for the Swan Lake-Lake Tyee Powerline Intertie Project. Interviews were conducted with knowledgeable subsistence users in Wrangle, Ketchikan, and Saxman to verify the relatively light use patterns as indicated by ADF&G harvest statistics. Organizations contacted to identify potential respondents include the Ketchikan Indian Corporation, Saxman Tribal Council, the Wrangell Indian Reorganization Act group, and the Southeast Alaska Federal Subsistence Advisory Council.

The primary purpose of the contacts was to determine whether the existing information adequately represents subsistence harvest activity in the Project Area. The personal contacts confirm the available data except that the results suggest that subsistence use of the area is probably under reported in the ADF&G statistics.

Affected Areas

Based on identified use of the Project Area, the following communities were selected to be analyzed: Metlakatla, Meyers Chuck, Saxman, Wrangell, Thorne Bay, and Ketchikan. Of these communities, all are designated rural except Ketchikan.

Metlakatla

Metlakatla is 41 nautical miles south of the Upper Carroll Project Area and on the west side of Annette Island. The 1990 census reported there were 1,407 people living in the community, of which 1,175 or 84 percent were Native. This community was established in 1887 when a band of Tsimshian Natives migrated from northern British Columbia. In 1891, Congress designated Annette Island an Indian reservation, the first in Alaska. The community did not participate in the Alaska Native Claims Settlement Act of 1971 (ANCSA) and does not have a village corporation. Their economy is based on sawmill operations of the Louisiana Pacific Annette Hemlock Mill, Annette Island Packing Company (a community owned cannery), Tamgas Creek Hatchery, and Metlakatla Indian Community Services.

Metlakatla subsistence use is over 71 pounds of edible harvest consumed per person per year. This supplements their relatively low income and traditional cultural lifestyles. In the Project Area, Metlakatlans fish for salmon and hunt for deer.

Meyers Chuck

Meyers Chuck is a small fishing village with a seasonal population of 30 to 40 people located about 35 miles from the Project Area along the Clarence Strait on the northwest tip of Cleveland Peninsula. A natural, well protected harbor, Meyers Chuck has been a shelter for passing fishing boats caught in the stormy waters of Clarence Strait Beginning in the late 1800s, the community grew after a cannery was established in Union Bay in 1916. Fishing is still the basic source of income, although declining salmon populations have caused some residents to seek work in Ketchikan or on Prince of Wales Island. A community-sponsored fish hatchery was constructed in 1977, with the hope of improving local fish supplies.

Meyers Chuck residents depend on subsistence activities to supplement the relatively low cash economy. Fish, berries, deer, and other local protein sources are an important element of the local economy. Subsistence use of salmon and deer within the Project Area has been reported by residents of Meyers Chuck. Over 414 pounds of edible harvest are consumed per person per year.

Saxman

Saxman was settled in 1894, by Tlingit Natives from Cape Fox and Tongass Islands. The town was named after a Presbyterian teacher named Samuel Saxman, who along with a Native village elder, were lost at sea looking for a new school site. When established, a few Tlingits from the old village of Kahshakes joined the growing community. Under ANCSA, the Cape Fox Corporation was formed and is the economic base for Saxman. Cape Fox Corporation is counted among one of the major employers in the Ketchikan area, including the Westmark Cape Fox Lodge, Cape Fox Tours, and as owner of 23,000 acres of forested land.

Today, about 266 villagers consume an average of 89 pounds of food per capita per year from subsistence activities. In the Project Area, residents of Saxman travel 30 miles to fish for salmon, hunt for deer and bear, and trap for marten, crab, and shrimp.

Wrangell

Wrangell, located in the east-central portion of Southeast Alaska, is on the northern tip of Wrangell Island about 7 miles from the mouth of the Stikine River and approximately 50 air miles from the Project Area. The 1990 population is reported as 2,479. Wrangell began as an important Tlingit site primarily because of its proximity to the Stikine River. Starting in 1811, the flags of three nations—England, Russia, and the United States—have flown over this community, with Russian and English interests centered on fur trading. When the United States purchased Alaska in 1867, a military post was established. Prospecting for gold along the Stikine River and later in the Cassiar District of northern British Columbia dwindled by 1916, and the economy changed to fishing, crabbing, and shrimping. Today, fishing and fish processing dominate Wrangell's economy. More than 100 residents fish commercially. It is the major source of income for 50 percent of those residents. Tourism is a growing economic influence in the Wrangell area.

Wrangell subsistence use is approximately 164 pounds consumed per person per year. In the Project Area, their reported use is for deer, salmon, crab, shrimp, and halibut.

Thorne Bay

Thorne Bay is one of the youngest cities in Alaska. As the center of logging activity for the Ketchikan Pulp Company, the community quickly grew from a logging camp in 1962, to an incorporated city in August 1982. Prince of Wales Island may be reached by the Alaska Marine Highway; Thorne Bay is accessible by road from the Alaska Marine Highway, other Prince of Wales communities, or by float plane. Thorne Bay is a full service community of fewer than 500 residents, with schools, medical and government facilities.

Currently, the economy of Thorne Bay is based on logging, commercial fishing, and charter boat operations. Fishing activities center around Thorne River, which has large runs of salmon and trout. Crabbing, clamming and shrimping are popular activities in the waters adjacent to the community.

Thorne Bay residents use the Project Area for deer hunting, but the use is light. About 187 pounds of subsistence food is consumed per person each year.

Ketchikan

Ketchikan is located in southern Southeast Alaska, on the southwest side of Revilla Island on Tongass Narrows opposite Gravina Island. Ketchikan is approximately 30 air/water miles from the Project Area.

The Ketchikan area was a summer fishing camp for the Tlingit Indians. Development began with a saltery at the mouth of Ketchikan Creek. Ketchikan was a boom town in the late 1800s. Since the early 1900s, timber products have been an important economic factor in Ketchikan. Because of its location as a transportation center, fishing center, and focus for the region's timber industry, Ketchikan grew rapidly in the 1950s. In 1954, a world scale pulp mill was built in Ward Cove, with a computer aided, laser scanning sawmill added to the site in 1989. Besides the pulp and saw mills, Ketchikan has over a dozen large and small fish processing establishments. While mining does occur within the area, it is not currently of any major economic significance.

Ketchikan's 1990 borough population was reported as 13,828. Ketchikan was not included in the TRUCS study, since it is defined as nonrural. Consequently, subsistence harvest information for this community is not available except for fish and game harvest information provided by ADF&G.

Other Communities and Camps

In addition to communities already discussed, the following are other communities that use the Project Area for subsistence gathering purposes: Loring, Margaret Bay Camp, Shoal Cove, and Neets Bay Hatchery Camp. Subsistence use by these communities is expected to have minimal impact on the area.

Table Subsistence-1 presents information taken from the 1988 TRUCS report detailing the importance of subsistence use for individual communities using the Project Area. Total harvest figures include additional food items, plants, and berries.

Table Subsistence-1
Per Capita Subsistence Harvest for Rural Communities Which Use the Project Area for Subsistence Gathering Activities.

Community	Total Harvest Lbs.	Deer Harvest Lbs.	Other Mammal Lbs.	Salmon Harvest Lbs.	Other Fish Lbs.	Shellfish Harvest Lbs.	Birds/ Eggs Lbs.	Misc. Plants Lbs.
Metlakatla	71	11	1	20	18	15	2	4
Meyers Chuck	414	22	37	105	176	52	14	8
Saxman	89	17	7	33	19	9	1	3
Thorne Bay	189	37	6	48	74	19	2	3
Wrangell	164	20	24	30	43	41	2	4

SOURCE: ADF&G Community Profile Database Catalogue, Vol 1, 1991

Affected Resources

The Project Area supports a wide variety of resources that contribute to the maintenance of the subsistence lifestyle. Identified activities include harvest of fish, waterfowl, bear, deer, furbearers, clams, crab, and shrimp; and the gathering of berries and seaweed. In addition, many residents use trees for firewood, lumber, and spruce roots and cedar bark for cultural expression. Of these resources, fish, deer, black bear, furbearers, and waterfowl may be affected by the Upper Carroll Project and are analyzed in the following discussion.

Fish

Salmon and trout are the principal subsistence fish resources in the affected area. Pacific salmon are harvested in both fresh and saltwater in a variety of ways throughout the year in the Project Area. The Sockeye and Chinook salmon are the most heavily used subsistence species because of their high quality flesh and ease of harvest at traditional sites. Traditional harvest sites for salmon within the Project Area include chum salmon at Neets Bay and pink, sockeye, and chum salmon at the mouth of Carroll Creek.

Table Subsistence-2 lists the stream, number of subsistence permits issued, and the number of fish taken by species for subsistence purposes. Neets Bay and at the mouth of Carroll Creek are shown as the principal salmon subsistence use areas in the Project Area.

Table Subsistence-2
Salmon Personal Use Permits and Harvest 1985-94

Location & Year	Permits Issued	Salmon Taken Chinook	Salmon Taken Sockeye	Salmon Taken Pinks	Salmon Taken Chums
1985					
Carroll Creek	20	0	3	34	2
1986					
Carroll Creek	3	0	10	0	0
1990					
Neets Bay	1	0	12	0	0

SOURCE: ADF&G Commercial and Subsistence harvest data

Wildlife

For record keeping purposes, the ADF&G has broken the Game Management Units (GMUs) into smaller areas called minor harvest areas. Minor harvest units are approximately comparable to WAAs. WAAs and their corresponding Value Comparison Unit (VCUs) within the Upper Carroll Project Area are found in Table Subsistence-3.

Table Subsistence-3
VCUs Within the Upper Carroll Project Area

WAA	VCUs
406	744, 746
510	737

SOURCE: Matson 1995

Only about 5 percent of WAA 510 and about 24 percent of WAA 406 are within the Upper Carroll Project Area.

Deer

Harvest of deer on the Project Area is from rural users and non-rural users. Communities whose residents have hunted deer in WAA 510 since 1984 include: Ketchikan, Neets Bay, Margarita (Margaret) Bay logging camp, Loring, Juneau, Saxman, and Thorne Bay. Subsistence users came from: Metlakatla, Meyers Chuck, Saxman, Thorne Bay, Wrangell, Hydaburg, and Tenakee Springs. (Resource Harvest Map 1990, ADF&G). Access is limited to boat or float plane.

Hunting effort in WAA 510 increased in 1989 due to the resumption of logging operations in the area. Most of the additional harvest was by Margarita (Margaret) Bay logging camp residents. Harvest may increase as more logging, road building, and other development occur in the Upper Carroll Project Area.

The general hunting season is August through late December. Harvest is concentrated during two time periods: the first few weeks of the season in August, and later in November when the rut occurs. Most of the deer harvest in the Project Area occurs on shorelines or timber harvest access roads.

Locations where communities harvested deer within the Upper Carroll Project Area during 1987 to 1993 period are shown below in Table Subsistence-4.

Table Subsistence-4
VCUs within the Project Area Where Subsistence Communities Harvested Deer During 1987-93

VCU	Metlakatla	Meyers Chuck	Saxman	Wrangell	Thorne Bay
737					x
744	x		x		
746	x		x		

Source: Matson 1995. ADF&G Deer Harvest Data Base

The average number of deer harvested from 1987 through 1991, by each community for WAAs 406 and 510, is shown in Table Subsistence-5. Ketchikan was included to illustrate the relative impact this community has on the area. An average of 12 deer per year in WAA 510 were taken by hunters from rural communities.

Subsistence hearings held in Ketchikan and Saxman revealed that some Saxman residents do not report their deer harvest to ADF&G, which indicates that the ADF&G harvest data is under-reporting the importance of this area to residents of Saxman. Another problem with the ADF&G harvest data is that some Saxman residents have a Ketchikan mailing address, so some Saxman resident deer harvest is being reported as Ketchikan resident harvest.

Table Subsistence-5
Average Deer Harvest by Community and WAA for the Years 1987-93

Community	WAA 406	WAA 510
Ketchikan	58	28
Loring	0	0
Margarita Bay Logging Camp	0	5
Metlakatla	1	0
Meyers Chuck	0	0
Neets Bay	0	4
Saxman	2	0
Shoal Cove	2	0
Thorne Bay	0	3
Wrangell	0	0
Outside Alaska	1	0
Total Deer Harvest	**64**	**40**
Total Non-rural Harvest	**59**	**28**
Total Rural Harvest	**5**	**12**

SOURCE: ADF&G Deer Harvest Data For Southeast Alaska 1987-93.

The percentage of a community's deer harvest occurring within WAAs 406 and 510 is illustrated in Table Subsistence-6.

Table Subsistence-6

Average Deer Harvest by Community 1987-1993 and Percent of Total Harvest that Occurred Within WAAs 406 and 510

Community	Average Deer Harvest Within Project WAAs	Average Deer Harvest All Areas	Percent of Harvest Within Project WAAs
Ketchikan	86	1,575	5
Loring	0	0	0
Margarita Bay Camp	5	5	100
Metlakatla	1	39	3
Meyers Chuck	0	17	0
Neets Bay	4	4	100
Saxman	0	7	0
Shoal Cove	2	2	100
Thorne Bay	3	352	<1
Wrangell	0	348	0
Outside AK.	1	70	1

SOURCE: ADF&G Deer Harvest Data For Southeast Alaska 1987-93.

While Ketchikan accounted for the greatest number of deer harvested within the Project Area (86), it amounted to six percent of that community's total deer harvest (1,575). People living at the Neets Bay hatchery and Margarita (Margaret) Bay Logging Camp harvested all their deer from the Project Area WAAs. The Margarita (Margaret) Bay Logging Camp is no longer in the Project Area; however, this level of harvest could be expected when another logging camp is moved in to harvest the proposed timber. The community of Thorne Bay's deer harvest showed up in the data only for the year of 1989. It is suspected that this harvest was by individuals who were staying at a logging camp. Since the deer harvest for the community of Thorne Bay occurred in only one year out of seven, it probably is not a particularly important subsistence use area for the community of Thorne Bay.

The TLMP RSDEIS (1996a) produced a map that displayed areas used for subsistence deer hunting by Southeast Alaska subsistence households; this map is incorporated by reference. This map shows that most of the Project Area has been used by only one to ten subsistence households, with the exception of along the shoreline in Neets Bay and Carroll Inlet.

Black Bear

Black bears occur throughout the Project Area and populations are currently stable.

The TRUCS effort indicated that some black bear harvest was associated with subsistence use, but that community use varies widely. Bear tagging information from ADF&G indicates hunters were usually from the Ketchikan area; only one bear out of 182 was harvested by a resident of rural community (Neets Bay). It is very possible that more bear were harvested by rural residents if they had a Ketchikan or Ward Cove mailing address, but lived in Saxman or Neets Bay. Non-Alaskan residents harvested 21 of the 182 bear.

Table Subsistence-7 displays the black bear harvest by WAA by year.

Table Subsistence-7
Black Bear Harvest from 1986 to 1993 and Population Needed to Support Harvest Compared to Current Habitat Capability

WAA**	1986	1987	1988	1989	1990	1991	1992	1993	Average Harvest Per Year	Population to Support Harvest*
406	20	17	1	19	22	11	6	17	14	140
510	8	17	5	6	11	10	4	8	9	90

SOURCE: Matson 1995. Data derived from ADF&G harvest data

* Population needed to support harvest assumes a 10 percent harvest of the population (pers. comm. D. Larsen, ADF&G Wildlife Biologist).
** Includes entire WAA, including portions outside the Project Area.

Table Subsistence-8 displays the black bear harvest in WAAs 406 and 510 broken down by harvest of individuals from rural and non-rural communities.

Table Subsistence-8
Black Bear Harvest by Rural and Non-rural Communities During 1986-93

	WAA 406		WAA 510	
Year	**Rural Harvest**	**Non-rural**	**Rural Harvest**	**Non-rural**
1986	0	20	0	8
1987	0	17	1	16
1988	0	1	0	5
1989	0	19	0	6
1990	0	22	0	11
1991	0	11	0	10
1992	0	6	0	4
1993	0	17	0	8
Total	**0**	**113**	**1**	**68**

SOURCE: Matson, 1995. ADF&G Black Bear Harvest Data Base

Furbearers

Furbearer harvest supplements the seasonal income of many area residents. Different levels of trapping intensity exist, from the occasional trapper who targets primarily marten and otter close to shore, to those individuals pursuing all furbearers both near to and far from the road system. Harvest effort usually is concentrated along the saltwater/upland interface. Marten appear to be the most old-growth dependent of the furbearers and are trapped intensively from shore and along the road system. All of the marten trapped in WAA 510 where trapped by residents of Ketchikan and Ward Cove. Residents of Bell Island, Neets Bay, and people staying at the Margarita Bay logging camp harvested 40 percent of the marten in WAA 510; the other 60 percent were harvested by residents of Ketchikan and Ward Cove (ADF&G Marten Harvest Database). It should be noted that there are wide yearly variations in harvest levels.

Table Subsistence-9
WAA 406 Furbearer Harvest from 1988 to 1993

Animal	1988	1989	1990	1991	1992	1993	Total	Average Harvest Per Year	Population Needed to Support Harvest *
Beaver	2	2	0	4	3	9	20	4	N/A
Marten	8	33	20	73	6	1	141	24	60
Otter	7	12	13	15	14	23	84	14	70
Wolf	2	1	1	1	3	1	9	2	10

SOURCE: ADF&G Data Base

* Population needed to support harvest assumes a 40 percent harvest of the marten population and a 20 percent harvest of the otter and wolf populations.

Table Subsistence-10
WAA 510 Furbearer Harvest from 1988 to 1993

Animal	1988	1989	1990	1991	1992	1993	Total	Average Harvest Per Year	Population Needed to Support Harvest
Beaver	0	2	0	20	0	0	22	4	N/A
Marten	100	99	91	116	1	4	411	69	173
Otter	3	22	5	23	1	6	60	10	50
Wolf	2	5	0	2	10	2	21	4	20

SOURCE: ADF&G Data Base

* Population needed to support harvest assumes a 40 percent harvest of the marten population and a 20 percent harvest of the otter and wolf populations.

Table Subsistence-11
Marten Harvest by Rural and Non-rural Communities During 1988-93

	WAA 406		WAA 510	
Year	Rural Harvest	Non-rural	Rural Harvest	Non-rural
1993	0	1	0	4
1992	0	6	1	0
1991	0	73	127	0
1990	0	20	43	48
1989	0	33	6	93
1988	0	68	0	100
Total	**0**	**201**	**177**	**245**

Source: Matson 1995. ADF&G Marten Harvest Data Base

Waterfowl

A variety of species of ducks, along with Canada geese, occur in the Project Area, primarily along bays and estuaries. Identified sites with a history of waterfowl use that are within the Project Area include:

- Carroll Creek estuary
- Neets Bay

810 Evaluation-Effects of the Alternatives

Introduction

Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA) requires a Federal agency having jurisdiction over lands in Alaska to evaluate the potential effects of proposed land-use activities on subsistence uses and needs. Section 810 of ANILCA states:

> *In determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands under any provision of law authorizing such actions, the head of the agency having primary disposition over such lands or his designee shall evaluate the effects of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes. No such withdrawal, reservation, lease, permit, or other use, occupancy or disposition of such lands which would significantly restrict subsistence uses shall be effected until the head of such federal agency:*
>
> 1. *Gives notice to the appropriate state agency and appropriate local committees and regional councils established pursuant to ANILCA Section 805;*

2. *gives notice of, and holds, a hearing in the vicinity of the area involved; and*

3. *determines that: (a) such a significant restriction of subsistence uses is necessary and consistent with sound management principles for the utilization of the public lands; (b) the proposed activity will involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other disposition; and (c) reasonable steps will be taken to minimize adverse impacts upon subsistence uses and resources resulting from such action.*

This section evaluates how the proposed action alternatives could affect subsistence resources used by the rural communities found to use the Project Area, including: Metlakatla, Saxman, Thorne Bay, Meyers Chuck, Wrangell, and the non-rural community of Ketchikan. The subsistence resource categories evaluated are deer, furbearers, waterfowl, black bear, salmon, other finfish, shellfish, other food and cultural resources, and firewood.

Criteria used to evaluate the effects of the proposed alternatives are: (1) changes in abundance or distribution of subsistence resources; (2) changes in access to subsistence resources; and (3) changes in competition from non-rural users for those resources. The evaluation determines whether subsistence uses in the Project Area or portions of the Project Area may be significantly restricted by any of the proposed action alternatives.

The evaluation relies heavily upon the use of wildlife habitat capability models as well as upon ADF&G hunter survey data.

This subsistence evaluation considers whether or not there is a significant possibility of a significant restriction of subsistence use. The Alaska Land Use Council's definition of "...significantly restrict subsistence use" is one guideline used in the findings. By this definition:

A proposed action shall be considered to significantly restrict subsistence uses, if after any modification warranted by consideration of alternatives, conditions, or stipulations, it can be expected to result in a substantial reduction in the opportunity to continue subsistence uses of renewable resources. Reductions in the opportunity to continue subsistence uses generally are caused by: reductions in abundance of, or major redistribution of resources; substantial interference with access; or major increases in the use of those resources by non-rural residents. The responsible line officer must be sensitive to localized, individual restrictions created by any action and make his/her decision after a reasonable analysis of the information available.

The U.S. District Court Decision of Record in Kunaknana v. Watt provided additional definitions of "...significant restriction of subsistence uses" and are also used as guidelines in the findings. The definitions from Kunaknana v. Watt include:

Significant restrictions are differentiated from insignificant restrictions by a process assessing whether the action undertaken shall have no or slight effect as opposed to large or substantial effects. In further explanation, the Director (BLM) states that no significant restriction results when there would be "no or slight" reduction in the abundance of harvestable resources and no occasional redistribution of these resources. There would be no effect (slight inconvenience) on the ability of harvesters to reach and use active subsistence harvesting site; and there would be no substantial increase in competition for harvestable resources (that is, no substantial increase in hunting by non-rural residents).

Conversely, restrictions for subsistence uses would be significant if there were large reductions in abundance or major redistribution of these resources, substantial interference with harvestable access to active subsistence use sites or major increases in non-rural resident hunting. In light of this definition, the finding of significant restriction must be made on a reasonable basis, since it must be decided in light of the total subsistence lands and resources that are available to individuals in surrounding areas living a subsistence lifestyle. This EIS evaluates the availability of subsistence resources in surrounding areas that could be accessed without undue risk or economic hardship to subsistence users.

Direct, Indirect, and Cumulative Effects on Subsistence Use of Deer

A decrease in habitat capability of less than one percent for all alternatives in WAAs 406 and 510 as illustrated in Table Subsistence-12.

Table Subsistence-12
Percent Decrease from 1995 Deer Habitat Capability by Alternative

WAA	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
406	0	<1	<1	<1	<1	<1
510	0	<1	<1	<1	<1	<1

SOURCE: Burns 1996

Based on the outputs of the Habitat Capability Models for deer, only minor changes in current habitat levels would occur in WAAs 406 and 510 . Current demand is assumed to be the average deer harvest from 1987-93, for each of the Project Area WAAs. To determine future demand for deer, the current demand was increased by 1.8 percent per year though the year 2010, and 1.5 percent per year from 2010 to the year 2040.

Deer: Reasonably Foreseeable Future Actions

Table Subsistence-13 displays the effect of harvesting Upper Carroll and other planned harvest activities taking place on Revillagigedo Island between now and the year 2004 (end of the Long-term Contract with KPC). Table Subsistence-13 also compares the deer habitat capability in 2004 and the 1991-1995 ADF&G Deer Population Objectives as a percentage of the current habitat capability for all the WAAs on Revillagigedo Island. Habitat capability meets or exceeds ADF&G Deer Population Objectives in WAAs except 407 and 510. All WAAs that are below the Population Objective still have a remaining habitat capability within 90 percent of the Objective.

ADF&G Deer Population Objectives for WAAs 407 and 510 have been set at the current habitat capability due to significant habitat reductions caused by timber harvest or high hunting demand.

Table Subsistence-13
Deer Habitat Capability Reductions on National Forest System Lands, by Project and WAA for Revillagigedo Island by 2004

		Percent Habitat Capability Reduction for Deer on National Forest System Lands					Percent of Current Habitat Capability	
WAA	FS Lands Current Habitat Capability	Shelter Cove	Revilla EIS Alt. 6	Upper Carroll Alt. 2	Sea Level EIS *	Total Reductions	Habitat Capability 2004	ADF&G Population Objective
404	3,063					0	100	100
405	2,103				4	4	96	79
406	2,659	6		<1		6	94	83
407	1,126	7				7	90	100**
408	478					0	100	100
509	1,385		<1			<1	100	79
510	1,947		5	<1		5	95	100**
511	306					0	100	100
Total	**13,067**	**2**	**<1**	**<1**	**<1**	**3**	**97**	**91**

SOURCE: Burns 1996.

* Proposed EISs that have not been analyzed yet. Habitat capability reductions were estimated (using a 1.3 reduction in deer habitat capability for every MMBF).
** Projects in this WAA will reduce the habitat capability to less than the ADF&G Deer Population Objectives.
Note: Habitat capability assumes the harvested units are in the clearcut stage (0-25 years).

At first glance, Table Subsistence-13 appears to underestimate the impacts to deer winter habitat. A reduction in habitat capability for deer of approximately one percent from harvesting almost 2,000 acres (Alternative 2 only) seems low. The figures were checked by hand for accuracy. The relatively low loss of habitat capability is due to the fact that relatively few units are located in high value deer winter habitat. Much of the high and moderate value winter habitat was removed during previous timber harvest operations which harvested much of the habitat at low elevations in Carroll Creek and in Neets Bay. The model tends to emphasize the importance of large blocks of old-growth forest. Therefore, the first entry into an area for harvest typically shows a large reduction in habitat capability. This is shown in Table Wildlife-3 as a relatively high amount of habitat capability was lost between 1954 and 1995.

The units in the Upper Carroll project mainly harvest units on higher elevations and north or west facing slopes, thereby avoiding most of the remaining high value deer winter habitat. This is reflected in Table Subsistence-13. Eighty percent of the harvest will occur in habitat of low or no value (according to the model) and three percent is located in high value habitat.

Table Subsistence-14 displays the reasonably foreseeable action occurring on Prince of Wales Island. This table is included because many Ketchikan and Saxman residents take the ferry to Hollis and utilize the road system on Prince of Wales Island for deer hunting. The community of Ketchikan harvests approximately 50 percent of their deer from Prince of Wales Island (ADF&G Deer Harvest Data).

Table Subsistence-14
Deer Habitat Capability Reductions on National Forest System Lands, by Project and WAA for Prince of Wales Island by 2004

		Percent Habitat Capability Reduction for Deer on National Forest System Lands						Percent of Current Habitat Capability	
WAA	FS Lands Current Hab.Cap.	Polk FEIS Alt. 2	Lab Bay Alt. B	CPOW Alt. F5	CPOW Next Entry	Salt Lake EA Alt. 3	Control Lake Estimate	Habitat Capability 2004	ADF&G Population Objective
1107	6,915	*						100	76
1211	2,187							100	76
1212	1,362							100	75
1213	1,197	1						100	76
1214	1,749	1						99	83
1315	2,838			3	3			96	100**
1316	827							100	100
1317	1,093	2						98	100**
1318	1,796						2	98	100**
1319	2,857			1	1		6	92	100**
1323	1,981					2	3	95	76
1332	2,805	*						99	82
1420	1,035			2	8			90	100**
1421	3,073			1	6		1	94	100**
1422	4,412			4	2			94	97**
1527	1,730		2	*	1			97	88
1528	378		3					97	100**
1529	2,501		3					97	100**
1530	1,861		2	*	3			95	100**
Total	**42,597**	*	*	**1**	**1**	*	**1**	**97**	**90**

SOURCE: Matson 1995. Data derived from ADF&G Hunter Survey Summary Statistics 1987-1991.

* Less than one percent.
** Projects in this WAA will reduce the habitat capability to less than the ADF&G Population Objectives.

Table Subsistence-15
Percent Change from 1954 in Habitat Capability Effects for Deer

WAA	Current 1995 Change	Indirect 2040 Change	Cumulative 2140 Change
406	- 9	-10	-48
510	-30	-30	-62

SOURCE: Burns 1996

Assuming that all suitable timber is harvested by the year 2140, there would be a 48 percent reduction in habitat capability in WAA 406 and a 62 percent reduction in WAA 510. Using the assumption that there will be a constant increase in demand for deer, at sometime in the future demand may exceed the deer habitat capability, but that exact time is difficult to predict given the many variables such as weather, human population increases, road access, and the desire to hunt certain areas.

Effects resulting from changes in access may be the most significant potential effects of the project. If a road network connected to Ketchikan were to develop, the effects on subsistence users may be significant. Ketchikan hunters dominate the harvest within their land use area. At present, Ketchikan's use of the Project Area is limited by the lack of road access. Road access would make it easier for the much larger pool of Ketchikan hunters to use the Project Area. Most of the roads would be closed following project completion to mitigate some of the potential impacts of competition.

Direct, Indirect, and Cumulative Effects on Subsistence Use of Other Resources

Black Bear

The direct effects of the proposed action on black bear habitat capability is less than one percent. There is no indication from the models that black bear habitat capability will be significantly diminished due to the proposed action as illustrated by Table Subsistence-16.

Table Subsistence-16
Percent Decrease from 1995 Black Bear Capability by Alternative

WAA	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
406	0	<1	<1	<1	<1	<1
510	0	0	0	0	0	0

SOURCE: Burns 1996

Indirect and cumulative effects on bear habitat capability are displayed in Table Subsistence-17, which exhibits the percent change to habitat capability.

Table Subsistence-17
Percent Change from 1954 in Habitat Capability Effects for Black Bear.

WAA	Current 1995 Change	Indirect 2040 Change	Cumulative 2140 Change
406	-<1	-2	-33
510	-8	-9	-35

SOURCE: Burns 1996

Assuming that all suitable timber is harvested by the year 2140, there would be a 33 percent reduction in habitat capability in WAA 406 and a 35 percent reduction in WAA 510.

Fish

Salmon are a major subsistence food harvested in Southeast Alaska. The Water Resources, Fisheries, and Riparian sections of this chapter conclude that potential effects of the proposed timber harvest and road construction activities on salmon spawning and rearing habitat would be minimal or eliminated by applying the Forest Service Standards and Guidelines from the TLMP RSDEIS (1996a), and prescriptions described in detail in the Aquatic Habitat Management Handbook, Tongass Timber Reform Act, and Soil and Water Conservation Handbook. The application of these standards, guidelines, and prescriptions also minimize immediate and foreseeable impacts to other finfish.

Furbearers

The direct effects of the proposed action are shown in Table Subsistence-18, Furbearer Habitat Capability by Alternative. Habitat capability estimates were derived from computerized models of management indicator species (MIS) for marten, otter, and wolf. Beaver is not MIS for this EIS.

Table Subsistence-18
Percent Change from 1995 Furbearer Habitat Capability by Alternative

WAA	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
406						
Marten	0	-2	-1	-1	-1	-1
Otter	0	-1	-1	-1	-1	-1
Wolf	0	0	0	0	0	0
510						
Marten	0	-<1	0	0	0	0
Otter	0	0	0	0	0	0
Wolf	0	0	0	0	0	0

SOURCE: Burns 1996

The habitat capability of the Project Area will remain essentially the same for river otter and for wolf. Marten will decrease two percent in WAA 406 for all alternatives.

Table Subsistence-19 is a summary of the cumulative effects on subsistence species of concern.

Table Subsistence-19
Percent Change from 1954 in Habitat Capability Effects on Furbearers

WAA	Current 1995 Change	Indirect 2040 Change	Cumulative 2140 Change
406			
Deer	-9	-10	-48
Black bear	<-1	- 1	-33
Marten	-8	-21	-47
Otter	-14	-14	-14
Wolf	-8	-44	-47
510			
Deer	-30	-30	-62
Black bear	- 8	-9	-35
Marten	-17	-25	-50
Otter	-20	-21	-21
Wolf	-23	-31	-46

SOURCE: Matson 1995

Table Subsistence-19 indicates that if all suitable timber is harvested by the year 2140, there could be about a 50 percent reduction in habitat capability, from 1954, for deer, marten, and wolf.

Waterfowl

Effects of the proposed action on waterfowl are expected to be minimal because no timber harvest will be permitted within 1,000 feet of estuaries or within 500 feet of shorelines. Timber harvest unit locations generally avoid important waterfowl areas, including: estuary grass flats, beach fringe, and borders of inland lakes and streams.

Firewood and Lumber

Current use of both live and dead timber for subsistence is very low throughout the Project Area. No need for wood in the Upper Carroll Project Area has been expressed. In terms of effects, there may be an immediate, localized, temporary use by logging camps, but indirect and cumulative demand is expected to return to current low use rates.

Other Resources

Other subsistence uses of the natural resources occur. Some examples are cedar bark gathering, berry picking, mushroom gathering, use of native plants for arts and crafts, use of bays and estuaries, collecting of other edible plants and animals. Most of these activities are associated with a particular traditional site.

ANILCA 810 Findings for Subsistence Use of the Project Area

Abundance and Distribution of Subsistence Resources

The harvest of old-growth habitat may reduce the abundance of deer, black bear, marten, and wolf based on the Habitat Capability models for these species. Timber harvest proposed by the action alternatives will reduce the deer habitat capability by less than one percent (Table Subsistence-12). Black bear habitat capability will be reduced by less than one percent for all action alternatives (Table Subsistence-16). Marten habitat capability in WAA 406 will be reduced by one to two percent (Table Subsistence-18). The most significant decrease in deer and marten habitat capability for WAA 510 is in 2140, 62 percent for deer and 50 percent for marten (Table Subsistence-19), as a result of additional timber harvest in the future as predicted by the 1996 TLMP RSDEIS. Other subsistence resources such as salmon, waterfowl, berries, edible plants, and cedar bark are not anticipated to be reduced in abundance. Distribution of the subsistence resources is not expected to change.

Access

Access to traditional subsistence-use areas will not be restricted by the proposed project. Traditional subsistence access is by boat to the beaches of the Project Area. The effect on access would probably be minor under all alternatives because no beach fringe will be harvested in the Project Area and less than one percent of the marine and estuarine habitat will be affected by logging activities.

New and rebuilt roads will provide access to areas that were not previously used for subsistence harvesting resources. (See Alternative maps, separate map packet, for details.) Miles of road proposed for construction can be found in the Roads and Facilities section. Mechanized use of the road system will be limited due to ability to access the Project Area by boat.

Road management prescriptions developed for Project Area roads take subsistence users' needs into consideration.

Competition

Competition for subsistence resources in the Project Area is a scoping issue. Subsistence users are concerned with competition from residents of Ketchikan. Since Ketchikan residents are considered non-rural; this competition can be regulated if it starts to restrict non-rural residents' ability to obtain subsistence resources. In the Wildlife section, the cumulative analysis discussed a potential road connection between the Project Area and the Ketchikan road system. If such a connection is made, it would significantly increase the amount of rural and non-rural use of the area and could increase the amount of competition to the point that there would be a significant restriction in subsistence use of deer and marten in the Project Area.

The Federal Subsistence Board may use its authority to regulate non-rural harvest of deer and has authority to prioritize the harvest of deer among rural residents when necessary to protect the resource. The current deer population level does not require restrictions on non-rural users.

There is no evidence to indicate that availability of salmon, finfish, shellfish, or other food resources to subsistence users would be affected by sport or non-rural harvest. Any increase in competition from non-rural Alaskan residents and nonresidents would not be substantial because of the availability of resources in the immediate vicinity and in the surrounding areas.

The above analysis indicates that the actions proposed in Alternatives 2 through 7 will not represent a significant possibility of restrictions on subsistence use of deer, black bear, or otter in the Project Area. With future reductions of habitat capability for deer and marten, and in light of the fact that Saxman residents' use of the area is under-reported for the Project Area, there may be a possibility of significant restriction of subsistence use of marten and deer at some point in the future.

EIS Conclusions

Section 810 (a)(3) of ANILCA requires that when a significant restriction may occur, determinations must be made with regard to whether:

- Such a significant restriction of subsistence uses is necessary and consistent with sound management principles for the utilization of public lands;
- The proposed activity will involve the minimum amount of public lands necessary to accomplish the purposes of such use and occupancy, or other disposition;
- Reasonable steps will be taken to minimize adverse impacts upon subsistence uses and resources resulting from such actions.

Necessary and Consistent with Sound Management of Public Lands

The alternatives proposed in the Upper Carroll EIS have been examined to determine whether they are necessary and consistent with sound management of public lands. In this regard, the National Forest Management Act of 1976, the ANILCA, the Alaska Regional Guide, the TLMP, the TLMP 1985-86 Amendment, 1996 TLMP RSDEIS, the Alaska State Forest Practices Act, and the Alaska Coastal Zone Management Program have been considered.

The ANILCA placed an emphasis on the maintenance of subsistence resources and lifestyles. However, the Act also required the Forest Service to manage the forest for multiple use. The TTRA removed the 4.5 MMBF requirement from ANILCA, but directed the Forest Service "to the extent consistent with providing for the multiple use and sustained yield of all renewable forest resources, [to] seek to provide a supply of timber from the Tongass National Forest which (1) meets the annual market demand for timber from such forest, and (2) meets the market demand from such forest for each forest for each planning cycle," and left the volume requirements and contract area of the KPC contract in place.

The alternatives presented here encompass five different approaches that would produce the resources that would best meet the purpose and need of this EIS. All of the action alternatives involve some potential to affect subsistence uses. There is no alternative that will avoid a significant possibility of subsistence restrictions somewhere in the Forest. Therefore, based on the analysis of the information presented in this document on the proposed alternatives, these actions are necessary and consistent with the sound management of public lands.

Amount of Public Land Necessary to Accomplish the Purpose of the Proposed Action

Appendix A addresses the availability of other lands within the KPC contract area suitable for the timber harvest. Much of the Tongass National Forest is used by one or more rural communities for subsistence purposes for deer hunting. The areas of most subsistence use are the areas adjacent to existing road systems, the beaches, and the areas in close proximity to communities. Within the Project Area, the extent and location of the subsistence use areas precludes complete avoidance. Areas other than subsistence use areas that could be harvested may be limited by other resource concerns such as: soil and water protection; high value wildlife habitat; economics; visuals; or unit and road design. Effort was taken to protect the highest value subsistence areas such as the beach fringe, estuaries, and riparian areas.

The impact of viable timber harvest projects always includes alteration of old-growth habitat, which in turn always reduces projected habitat capability for old-growth dependent species. It is not possible to lessen harvest in one area and concentrate it in another without affecting one or more rural communities' important subsistence use areas. In addition, harvestable populations of game species could not be maintained in a natural distribution across the Forest if harvest were concentrated in specific areas. A well distributed population of species is also required by the Forest Service regulations implementing the National Forest Management Act (NFMA).

Reasonable Steps to Minimize Adverse Impacts Upon Subsistence Uses and Resources

Reasonable steps to minimize impacts on subsistence have been incorporated into development of the alternatives and project design criteria. Project design criteria called for locating roads and units outside of important subsistence use areas such as the beach fringe, estuary fringe, and riparian areas adjacent to salmon streams. During development of alternatives, an effort was made to minimize activities that could adversely affect important subsistence use areas.

Hearings

On the basis of findings of this analysis and under the provisions of the ANILCA, subsistence hearings were held on February 22, 1996, at Cape Fox Lodge in Ketchikan and on February 23, 1996, in Saxman. Letters were sent to the Federal Subsistence Board, ADF&G, Regional Fish and Game Advisory Councils, Local Fish and Game Advisory Committees, and to the Post Offices in Metlakatla, Meyers Chuck, Ketchikan, Saxman, and Thorne Bay to inform people of where hearings would be held. Announcements were also be made in the *Ketchikan Daily News* announcing the dates of the Subsistence Hearings.

Testimony received, both verbal and written, was analyzed and incorporated into the FEIS, as determined to be necessary by the Forest Service.

FEIS Conclusions

The Record of Decision (ROD) for the FEIS for the Upper Carroll Project includes a final Finding about the significant restriction on subsistence uses that may result from implementation of the Selected Alternative. Below is a summary of the FEIS evaluation and findings.

1. Hunting and trapping harvest levels of wolf and marten currently are at or exceed habitat capability for those species. In fact, hunting and trapping for wolf exceed the original 1954 habitat capability. Direct effects of the Upper Carroll Project, including the No-Action Alternative, may present a significant possibility of a significant restriction of subsistence uses of wolf and marten.

2. The direct effects from the action alternatives in the Upper Carroll Project do not present a significant possibility of a significant restriction of subsistence uses of deer, black bear, otter, marine mammals, waterfowl, salmon, other finfish, shellfish, and other foods.

3. The potential foreseeable and cumulative effects from implementing the Forest Plan (1996) through the entire rotation period, including the no-action and action alternatives in the Upper Carroll Project Area, may present a significant possibility of a significant restriction of subsistence uses of deer, marten, and wolf. Due to the possibility that Saxman residents' use of the Project Area is under-reported in the data, there is a possibility that at some point in the future it may be necessary to restrict the non-rural harvest of deer, marten, and wolf and give rural residents priority.

Table Subsistence-20 displays the summary comparison for subsistence use within the Project Area.

Table Subsistence-20
Summary Comparison of Alternatives

Activity/Resource	Units	Alternatives 1	2	3	5	6	7
Subsistence - WAAs 406 and 510							
High & Moderate Use Subsistence (TRUCS)	Acres harvested	0	0	0	0	0	0
Deer Habitat Capability	Percent of 1954 Habitat Capability	81	81	81	81	81	81
Deer Population Needed to Support Current Harvest	Percent of 1954 Habitat Capability	19	19	19	19	19	19
Significant Possibility of a Significant Restriction							
Direct Effects:							
Deer	Response	No	No	No	No	No	No
Bear	Response	No	No	No	No	No	No
Furbearers	Response	May	May	May	May	May	May
Salmon	Response	No	No	No	No	No	No
Other Finfish	Response	No	No	No	No	No	No
Waterfowl	Response	No	No	No	No	No	No
Marine Mammals	Response	No	No	No	No	No	No
Indirect & Cumulative Effects of Implementing the Forest Plan Over the Entire Rotation:							
Deer	Response	May	May	May	May	May	May
Bear	Response	No	No	No	No	No	No
Furbearers	Response	May	May	May	May	May	May
Salmon	Response	No	No	No	No	No	No
Other Finfish	Response	No	No	No	No	No	No
Waterfowl	Response	No	No	No	No	No	No
Marine Mammals	Response	No	No	No	No	No	No

SOURCE: Burns, 1996

Cultural Resources

Key Terms

Cultural Resources—all evidence of past human-related activity, dating from the earliest beginnings to the fairly recent past.
Sensitivity Zone—defined as "high" or "low," based on the probability that they might contain cultural resources.
SHPO—State Historic Preservation Officer.

Affected Environment

Introduction

Cultural resources include all evidence of past human-related activity, dating from the earliest beginnings to the fairly recent past.

The Upper Carroll Project Area has a unique cultural history, which includes the potential for occupation dating from the Paleomarine-Early Prehistoric Maritime period (10,000 B.C. - 4500 B.C.) through the Northwest Coast Developmental Phase-Late Prehistoric Maritime (4500 B.C. - A.D. 1700) to the protohistoric-historic Tlingit. Prehistorically, limited use of the rugged terrain in the Project Area is indicated. Only one stone fish trap and two wood-stake fish weirs have been identified. Historically, the various traders, miners, fishermen, loggers, subsistence users, and the USDA Forest Service (from 1907 to the present) have had an effect on the area. Historic sites include a cattle ranch, a cabin site, and culturally modified trees. A commercial fish trap was operated at the mouth of the Carroll River until the 1950s.

The oldest sites located in Southeast Alaska to date are approximately 10,000 years old and are characterized by microblades (small stone blades with sharp cutting edges) and microblade cores (the prepared stone from which blades are removed) (Ackerman 1985; Davis 1989, 1990). These types of tools are thought to be associated with cultures which adapted to a marine resource economy and which were present approximately 10,000 to 5,000 years ago. This technology seems to have been replaced by a ground and polished slate tool industry (Davis et al. 1989, Davis 1990). Historic sites represent the fishing, mining, and fur industries, as well as historic cabin sites and other post contact uses.

Many of these cultural remains provide the only record of former human occupation, work areas, and lifestyles. Some of these sites may represent cultural traditions associated with early human migration into Alaska, and others may be significant for European exploration and historic economic development. Additionally, some areas may have traditional or spiritual significance for contemporary Native Alaskans. The recovery of information from these sites and objects is important in reconstructing previous human behavior and adaptation in response to environmental or social change and represent an important part of our local, regional, and national cultural heritage.

3 Environment and Effects

Ethnohistory

The Upper Carroll Project Area is included in the traditional homeland of the Tlingit. Immediately prior to the time of European settlement, the Project Area was occupied by two Southern Tlingit groups, the Sanyakwan (also referred to as Saxman or Cape Fox Tribe) and the Tantakwan (also referred to as Tongass or Ketchikan Tribe). The northern half of Revillagigedo (Revilla) Island was also apparently occupied at one time by the Xetlkwan (Foam House People or the Stikine Tribe) who more recently reside in the Wrangell area.

The Stikine are said to have originally settled at the mouth of the Chickamin River. Both the Cape Fox and Tongass tribes have origin stories which suggest population movement from the mainland through the mouth of the Unuk River (on the mainland northeast of Revilla Island), but have had separate histories since that time. The original territory of the Cape Fox Tribe (from north to south) included the southwest portion of the Cleveland Peninsula, the southern half of Revilla Island, and the west coast of the mainland south to the Portland Canal area (Goldschmidt and Haas 1946: 134).

Although the Cape Fox Tribe remained in place on Revilla Island, the Tongass Tribe has a long history of migration. Originally centered on one-third of southern Prince of Wales Island, the Tongass Tribe, as a result of Kaigani Haida encroachment which began around 1720, migrated east. The resulting displacement and competition for resources eventually led to major conflicts between the Tongass and both the Cape Fox and Stikine Tribes in the early part of the nineteenth century. As a result, the Stikine abandoned the area and moved to Wrangell, their territory absorbed by the Cape Fox; the Tongass in the end effectively displaced the Cape Fox from their southern territory and the southwest coast of Revilla Island. By the end of the nineteenth century, however, due to increased Euro-American influence in the area, both groups consolidated and established separate settlements on the southwest coast of Revilla Island—the Tongass at the present day city of Ketchikan, the Cape Fox at Saxman (Arndt, Sackett and Ketz 1987: 85-162).

The historic period in Alaska began with the second Kamchatka Expedition of Vitus Bering in 1741 and developed through various stages of contact with European people and goods. Historic explorations in the Project Area occurred in 1792, with the Jacinto Caamano expedition, and in 1793, when George Vancouver's long boats explored Behm Canal from Port Protection where the British ships Discovery and Chatham were anchored (Mobley 1989; p9).

Figure Cultural-1 displays the areas of the Tongass, Cape Fox, and Stikine tribes in and around the Project Area as depicted by G.T. Emmons in 1888.

Figure Cultural-1
Upper Carroll Project Area Primary Native Cultures

Cultural Resources Inventory

In accordance with the National Historic Preservation Act of 1966, as amended, the National Environmental Policy Act (NEPA) of 1969, and a series of implementing regulations and policy direction, the Ketchikan Administrative Area of the Tongass National Forest is undertaking a program to identify, evaluate, preserve, and protect cultural resources as a nonrenewable national heritage. The purpose of the cultural resource investigations is to identify any possible impacts that the proposed activities would have on recorded cultural resources in the area that may be eligible for inclusion in the National Register of Historic Places.

Under a programmatic agreement (PA) with the Advisory Council on Historic Preservation and the Alaska State Historic Preservation Officer (SHPO), the USDA Forest Service, Region 10 has established guidelines that define high and low "sensitivity zones," based on the probability that they might contain cultural resources. Through a review and analysis of existing data, areas of high sensitivity for locating various historic or prehistoric site types have been determined. All areas between zero and 100 feet above sea level, in proximity to known site locations at any elevation, lakes and streams containing salmon species within 100 feet above sea level, areas of limestone or volcanic materials where caves or rock shelters are likely, passes and portages, known previous land use patterns, fossil beaches, mineralized zones where mining activity has occurred, and myth or legend sites are designated high sensitivity zones and require a search of existing data and field investigation. Low sensitivity zones include all other areas over 100 feet above sea level, muskegs, and areas where, because of specific environmental conditions, the probability of the occurrence of cultural resources is so low it is essentially zero.

The analysis process for the cultural resource inventory began with a search of the existing literature to identify any previous work, known cultural sites, and mining properties located within the Project Area and in or near proposed harvest units or road rights-of-way. A number of sources were consulted, including the Alaska Heritage Resources Survey (AHRS), the National Register of Historic Places (NRHP), the Forest Service site and survey files, and the Tongass National Forest Cultural Resource Overview (Arndt, Sackett, and Ketz 1987). A literature overview that included ethnohistoric information pertinent to Southeast Alaska Natives and other ethnic groups who have prehistoric or historic ties to the lands within the National Forest was supplemented by public comment and any additional reports submitted to the Forest Service that might pertain to the area presently under consideration.

Previous Work

Few systematic archaeological investigations have been conducted in the Project Area with the majority of the documentation contained in unpublished field notes on file. The following is a summary of investigations performed in the immediate vicinity of the Project Area and the subsequent findings.

- 1977: an aerial reconnaissance in the vicinity of Neets Bay revealed no cultural resources.
- 1978: a pedestrian reconnaissance of Shelter Cove documented one site, KET-015, located within the Project Area.
- 1978: a pedestrian reconnaissance around the head of the Carroll River revealed no cultural resources.
- 1982: a pedestrian reconnaissance at the head of Neets Bay located no cultural resources.

- 1990: a pedestrian reconnaissance of Shelter Cove located no additional cultural resources.
- 1992: a pedestrian reconnaissance of two timber harvest units for the Shelter Cove Independent Sale which are located within the Project Area located no cultural resources.
- 1992: a pedestrian reconnaissance of the head of Neats Bay located no cultural resources.
- 1995: a pedestrian reconnaissance for the Swan Lake-Lake Tyee Intertie identified two wood-stake fish weirs and a collapsed cabin.

Approximately 230 acres, located within the Project Area, have previously been investigated.

Five cultural resource sites—a stone fish weir, the site of a cattle ranch, two wood-stake fish weirs, and a collapsed cabin—are located in the Project Area. In addition, a number of culturally modified trees (CMTs) were identified.

Table Cultural-1 displays known sites by VCU, AHRS Site Number, relative elevation above sea level, whether the site is historic or prehistoric, and its location relative to the coast.

Table Cultural-1
Known Sites and Mines within the Project Area

Site Type	AHRS	Elevation	Date	Distance to Saltwater
VCU 737	KET-450	400	Historic	24288
VCU 744	KET-444	<100	Historic	4200
VCU 744	KET-448	<100	Prehistoric	2600
VCU 744	KET-449	<100	Prehistoric	4000
VCU 746	KET-015	<100	Prehistoric	<100

Total Number of Sites: 2

SOURCE: Reported ethnographic resource areas in the Project Area.

Traditional use areas indicated by Tlingit place names (Waterman 1922) along the Project Area's coastline have been identified. While place names do not always indicate the location of archaeological or historical resources (cultural resources), the place names suggest use and familiarity with geographic location and association with legends. All of these associations have varying degrees of potential for locating cultural resources. Tlingit place names in the Project Area as identified by Waterman are shown in Figure Cultural-2.

The information gathered from the data search and literature overview provided information about resource distribution, sensitivity to damage, and management of the resource. This work did not provide sufficient information with which to make informed decisions about the potential effects to significant cultural resource sites within the Project Area, however.

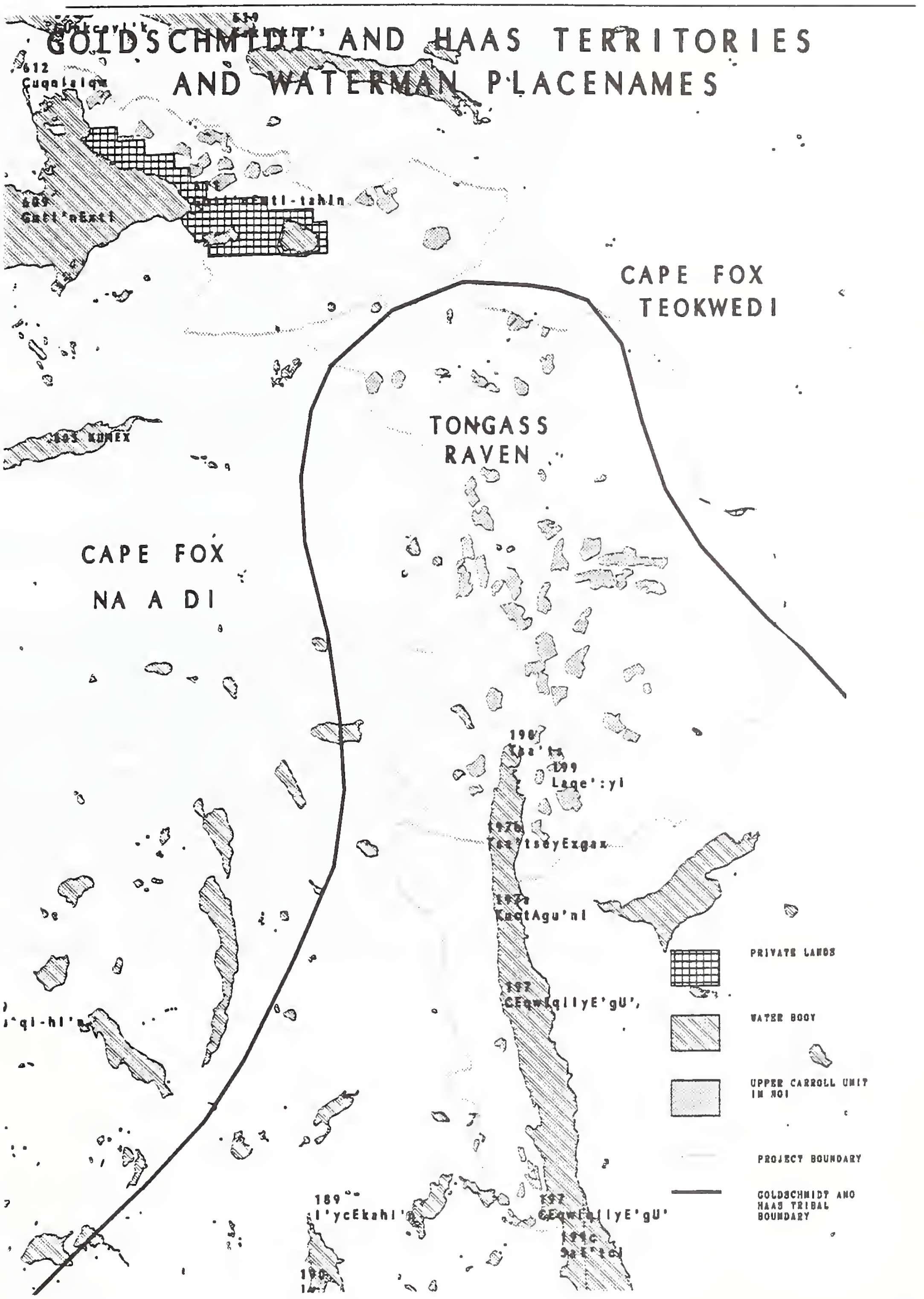
Figure Cultural-2: Legend
Tlingit Place Names for the Upper Carroll Project Area

No.	Waterman Name	Location	Waterman comment
197x	1/	North end Carroll Inlet	1/
197	Ceqw!qliyegu	Cove north of Nigelius Point	'rest cove'
611	Gutinext taheen	Neets Creek	'sea eggs creek'
197a	Kuctaguni	2.5 miles north of Nigelius Point	'land otter spring'
197b	Tsatseyexgax	0.6 miles southwest of Falls Creek	'little creek runs over cliff, looks like crying'
198	Tsa'ts	0.2 miles upstream from mouth of the Carroll River	'Place liked by seals, they swim up creek'

SOURCE: Waterman 1922. Assistance in modern spelling from Tongass Tribe and Ester Shea, July 1993.

1/ No Waterman Name or Comment listed

Figure Cultural-2
Tlingit Place Names for the Upper Carroll Project Area



Survey Strategy in the Upper Carroll Project Area

The Upper Carroll Inventory strategy involved sampling of the Project Area based on surveys that included all of the proposed project activity areas within the high sensitivity zone, additional areas where traditional subsistence activities and/or other cultural activities/sites were likely to occur, and a sample of timber harvest units in the low sensitivity zone. Specific areas included: inter-tidal areas, beach fringes, riparian zones, resource procurement areas, uplifted fossil beaches, passes or portages, myth and legend sites, karst topography and mineralized zones. A variety of other characteristics were also considered in designing where the surveys were to be conducted, such as eustacy (changes in sea level) and isostasy (rebounding of the earth's crust since deglaciation), and landform configurations. Due to elevation and sea level changes after deglaciation, the location of the earliest areas of human activity may be further inland and at higher elevations than subsequent human activity areas. The environmental characteristics that invited human use and habitation in prehistoric and historic times are often the same factors which invite use today.

Survey consisted of systematic pedestrian inspection of an area, subsurface examination through inspection of root wads, cut banks, or other natural exposures, and intensive soil probe testing. An inventory was prepared of culturally modified trees in the survey areas. This strategy resulted in maximum survey coverage in the areas of highest sensitivity for cultural resources.

There are no proposed timber harvest units located within the high sensitivity zone under any of the Action Alternatives.

Results of Cultural Survey

Intensive cultural resource survey in the Project Area in 1994 and 1995 included 302 acres in the high sensitivity and 105 acres in the low sensitivity zones. These surveys identified and documented one previously undiscovered cultural resource site, KET-444. The results of the survey of Waterman Native Place Name locations (see Figure Cultural-2, earlier in this section) indicates that many of these sites were probably locational names only. At a number of these identified locations, previous disturbance was noted that would in effect have eliminated intact cultural resource remains had they existed. The results of these investigations have been formalized in clearance report documentation and forwarded to the SHPO for review as required by the National Historic Preservation Act and 36 CFR 800. Additional intensive survey efforts, documentation, and SHPO review will be required should proposed activity areas be changed through project redesign, the acquisition of additional pertinent information, or as a result of SHPO comment prior to project implementation.

Specific locational information is protected to prevent vandalism or unauthorized use of these sites.

Effects of the Alternatives

Direct and Indirect Effects

Types of Potential Impacts

The preservation and protection of cultural resources are closely associated with the location of the resources, the nature of the management activity, and the environmental characteristics where management activities occur. Impacts to the resource may occur from natural forces, from public access, or from project-related activities. Erosion and other environmental effects may also lead to deterioration of cultural resource sites.

Timber harvest activities include the construction and reconstruction of roads, which can lead to an increase in opportunities for public use of cultural resources in the Project Area. Such increased use may enhance understanding of the past—capturing knowledge and information that can disappear over time due to natural decay—and may provide opportunities for interpretation and education. However, public use can destroy cultural resource sites through inadvertent damage caused by compaction or other ground disturbing activities. Vandalism—including relic collecting, defacement, and theft—results in the loss of information and the destruction of the resource. Protection of significant cultural resource sites from inappropriate public use includes the establishment of public education programs, maintaining confidentiality about specific site locations, monitoring, and directing the public away from the most vulnerable sites.

Specific Upper Carroll Potential Impacts

Alternatives 1-7 will result in no effects on cultural resources from the proposed activities, because of avoidance and the continued use of management recommendations.

Cultural Resource sites associated with proposed activities have been evaluated for significance through established criteria in 36 CFR 800. Site KET-015 is located in close proximity to the LTF at Shelter Cove. Current restrictions on the operation of the LTF to avoid the site area and monitoring of the site will continue. No timber harvest or road construction is planned within 0.2 miles of KET-444 under any of the proposed alternatives. KET-448, KET-449, and KET-450 are located less than 0.1 miles from previously constructed roads. Reconstruction of the road will not affect these sites.

The SHPO has concurred that there will be no effect to significant cultural resources from activities proposed for the Upper Carroll EIS.

Table Cultural-2 depicts the proposed harvest activity by alternative within the tribal areas by G.T. Emmons and Table Cultural-3 depicts prior harvest activity within the tribal areas.

Table Cultural-2
Proposed Harvest Activity by Alternative within Tribal Areas, as Described by Emmons (in acres)

Tlingit Tribal Group	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Sanyakwaan	881.62	349.78	642.94	230.00	0.00
Tantakwaan	1,114.43	745.75	974.95	802.11	590.68

Table Cultural-3
Prior Harvest Activity within Tribal Areas, as Described by Emmons (in acres)

Sanyakwaan	2271.05
Tantakwaan	1375.28

Cumulative Effects

Impacts from natural decay, landscape changes, private developments, and timber management activities collectively result in the loss of the cultural resources in Southeast Alaska. Development activities of all kinds pose particular threats to cultural resources as such activities tend to be located in the same areas that cultural resources are found, such as sheltered coastal settings.

It is impossible to determine the exact nature of resources that may have been previously disturbed in the Project Area. Intensive cultural resource investigations and mitigation measures have been implemented only since the 1980s. Current research and survey designs are based upon the results of previous work and modern methodology and technology. When combined with various mitigation measures, they will preserve significant sites and provide data that will guide future research and resource management.

Recreation

Key Terms

Developed recreation—A type of recreation that occurs where more facilities and amenities are incorporated into a site to accommodate intensive recreation activities in a defined area.
Dispersed recreation—A type of recreation use that requires few improvements or specific developed sites and may occur over a wide area. This type of recreation involves activities related to roads, trails, and undeveloped waterways and beaches.
Recreation Opportunity Spectrum (ROS)—A system for planning and managing six classes of recreation settings that are defined in terms of the degree to which they satisfy certain recreation experience needs.
Primitive (P)—An unmodified environment of fairly large size. Interaction between users is very low and evidence of other users is minimal. The area is essentially free from evidence of human-induced restrictions and controls. Motorized use is not present except for infrequent boats and planes.
Semi-Primitive Non-Motorized (SPNM)—A natural or natural appearing environment of moderate to large size. Concentrations of users is low, but there is often evidence of other users. No roads are present in the area.
Semi-Primitive Motorized (SPM)—A natural or natural-appearing environment of moderate to large size. Interaction between users is low, but there is often evidence of other users. Local roads used for other resource management activities may be present, or along saltwater shorelines there may be extensive motorized boat traffic.
Roaded Natural (RN)—A natural appearing environment with moderate evidence of the sights and sounds of humans. Such evidence usually harmonizes with the natural environment. Interaction between users may be moderate to high with evidence of other users prevalent. Motorized use is allowed.
Roaded Modified (RM)—A natural environment that has been substantially modified particularly by vegetative manipulation. There is strong evidence of roads and/or highways. Frequency of contact is low to moderate.
Recreation place—an identified geographic area having one or more physical characteristics that are particularly attractive to people engaging in recreation activities; can contain from zero to several recreation sites.
Recreation site—a specific location or site where recreational activities occur and/or a recreational facility is located; smaller in area than a recreation place.

Affected Environment

Introduction

The Upper Carroll Project Area bisects Revilla Island. It extends north of Revilla Channel, between George Inlet and Thorne Arm, north along the Carroll Creek watershed, then northwest to the Neets Creek watershed and Neets Bay. The area is essentially two river valleys joined at their upper watershed boundaries. The landscape character of the Project Area is generally 1,000- to 3,500-foot mountain ridges bounded by steep slopes plunging directly to saltwater and flat river valleys characteristic of glaciated topography.

Most of the recreation and tourism use in the Project Area takes place in the saltwater bays and channels within and adjacent to the Project Area. The Area receives significant local use for subsistence and recreation activities. Near the Project Area, saltwater areas are used by several resorts (Yes Bay Lodge frequents Neets Bay). Clients from these resorts engage in boating and fishing activities in waters adjacent to the Project Area. Parts of the Project Area provide the setting for those activities and are inventoried as Recreation Places.

Current Use

Recreation activities in or near the Project Area include fresh and saltwater sport fishing, hunting, camping, hiking, beachcombing, wildlife and scenic viewing, and boating (kayak, canoe, or motorboat). Flightseeing trips from nearby Ketchikan to Misty Fiords National Monument, recreation cabins, and the Swan Lake power plant sometimes occur. Although there are no recreation cabins in the Project Area, there are two nearby in the Orchard Lake area.

As there is no road connection from the Project Area to Ketchikan, access is achieved by personal or commercial boat and aircraft. Past timber harvest and small networks of associated roads are found at the mouth (estuary) of both Neets Creek and Lower Carroll Creek. Recreationists who reach these areas (35-40 miles from Ketchikan) enjoy viewing and hunting wildlife, including big game and waterfowl. Both freshwater and saltwater fishing is popular in the immediate vicinities.

Recreation Demand

Information about public demand for various recreation opportunities within the Project Area come from four sources—the Alaska Public Survey of 1979, an Alaska Department of Fish and Game (ADF&G) survey in 1989, from businesses and groups that discuss nonconsumptive uses of wildlife (i.e. wildlife viewing, photography), and the Ketchikan Community Survey of 1990.

Naturalness and remoteness associated with marine and freshwater recreation places were rated as ''very important'' by 80-90 percent of the recreation users of the Tongass National Forest. When asked about sensitivity to change, natural-appearing settings and solitude are the most important attributes. A sizeable number of Alaska residents indicate that they would stop going to their favorite places if development-related activities occurred on the site (Alaska Public Survey 1979).

The ADF&G survey related to wildlife viewing also indicated that those people engaged in this activity were concerned that various development activities such as logging, remote homesites, small aircraft use, and fish farming all could adversely effect the quality of their wildlife viewing experience.

Southeast Alaska residents highly value opportunities for remote, uncrowded outdoor recreation. At the same time, community access is important to those wanting to do more hunting, fishing, and beachcombing. In particular, Ketchikan residents want to see an expansion of the road system on Revilla Island primarily for the purpose of expanding roaded recreation opportunities (Ketchikan Community Survey 1990). Development of new hiking trails and bicycle paths are the most desired opportunities.

Recreation Opportunity Spectrum (ROS)

The process used to classify recreation opportunities on National Forest System lands is the Recreation Opportunity Spectrum (ROS). The ROS process is not a land management system, but rather is a method used to inventory an area's potential recreational opportunities. This system can be used to evaluate the changes that can occur in a given area as a result of different management prescriptions.

The ROS system portrays a range of recreation activities, settings, and experiences from primitive to urban. Criteria defining the various ROS settings are based on a variety of factors including: remoteness, landscape character, facilities present, amount of human modification to the natural landscape, and the opportunity for solitude. Of the six ROS classes, just three are present within the Project Area (see Figure Recreation-1, Inventoried ROS Classes Map). A summary of the existing acreages by ROS class is displayed in Table Recreation-1.

Nearly two-thirds (69 percent) of the Project Area is included within two ROS settings: Primitive (P) and Semi-Primitive (SPNM). Where timber harvest has occurred in the past, along low-lying shorelines (Shelter Cove) and river valleys (Neets and Carroll Creeks), Roaded Modified (RM) predominates. A network of roads access these areas but are not linked to any road system from Ketchikan nor are they linked to each other. Almost all of the Primitive ROS classes are on the north half of Carroll Creek drainage along alpine boundary ridges and the bowl-shaped upper basin of Carroll Creek.

Table Recreation-1
Existing Recreation Opportunity Spectrum (ROS) Classes in Acres

ROS Class	Acres
P	15,252
SPNM	16,326
RM	14,034
Project Area Total	**45,612**

SOURCE: GIS, Angelus 1996

Recreation Places

A recreation place is identified as a geographic area having one or more physical characteristics attractive to people engaging in outdoor activities. These places may be beaches, waterfalls, stream, lakes, scenic features, bays, anchorages, existing and potential recreation sites, and trails. Each Recreation Place has some activity associated with it such as hiking, camping, hunting, or viewing scenery or wildlife. These Recreation Places define the inventoried recreation areas which are important for existing and potential recreation uses. See the Visual Resource section in this chapter for further discussion on the scenic features or attributes of the Project Area.

There are four Recreation Places inventoried within the Project Area. Table Recreation-2 displays the Recreation Places within the Project Area including the number of acres, the ROS class, the existing and potential recreation sites and activities, and the current TLMP (1979a, as amended) LUDs and the proposed TLMP RSDEIS, Preferred Alternative (1996a) LUDs.

Table Recreation-2
Recreation Places Affected by the Upper Carroll Project

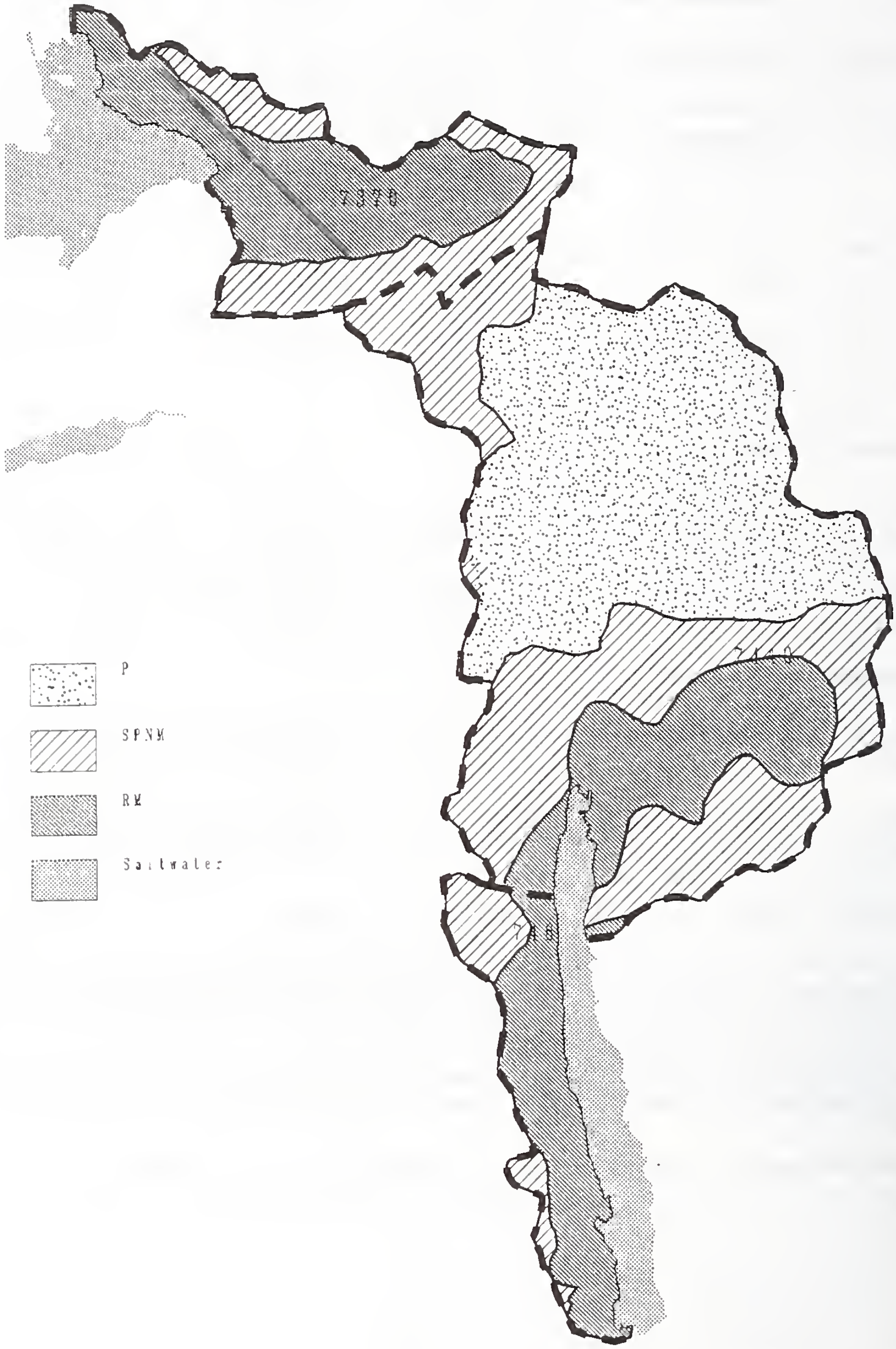
Area	Recreation Place	Acres	ROS	Recreation Activities	Recreation Sites	Current TLMP LUDs	TLMP Alt. 3 Prescription*
Carroll Inlet	1. Shelter Cove	1,658	Roaded Modified	boating, saltwater fishing, hiking,	boat dock (P) anchorage (E)	LUD III	ML
	2. Shoreline &Estuary	N/A	Roaded Modified	boating, saltwater fishing, scenic &wildlife viewing	boat dock (P) anchorage (P)	LUD III	ML
Neets Bay	3. Head of Neets Bay	1,284	Roaded Modified	boating, saltwater fishing	boat dock (E) anchorage (E)	LUD IV	ML
	4. Unnamed Cove Northside Neets Bay	916	Roaded Modified	boating, saltwater fishing	anchorage (E)	LUD IV	ML
Adjacent to Project Area:							
Swan Lake (1)	5. Swan Lake Picnic Area	N/A	Roaded Modified	lake fishing boating, picnicking	anchorage (E) boat dock	LUD IV	ML
Saddle Lakes (2)	6. Just west of Shelter Cove	N/A	Roaded Modified	camping, fishing picnicking	family campground (P)	LUD III	SV
Potential Recreation Places:							
Naha Rec Area (3)	7. Naha High Country Trail	N/A	Primitive	hiking, scenic viewing, fishing	trailhead (P) and trail	LUD IV	LUD II
Misty Fiords (4)	8. Mt.Reid Trail	N/A	Primitive	hiking, scenic & wildlife viewing	trailhead (P) and trail	LUD IV	W

(E) Existing Recreation Site (P) Potential Recreation Site (N/A) Not Available

(1) *Swan Lake & Creek:* is located on Carroll Inlet's east shore just south of the Project Area and is the site of the local power generation source for Ketchikan. An aerial crossing of Carroll Inlet occurs from here to the west shoreline, then south past Shelter Cove to beyond George Inlet.
(2) *Saddle Lakes Area:* is located just west of the very southern portion of the Project Area between Shelter Cove on Carroll Inlet and Upper George Inlet.
(3) *Naha Recreation Area:* is located immediately adjacent to the Project Area on its western boundary. Access from the Project Area is limited due to the absence of trails in the upper reaches of the Naha watershed.
(4) *Misty Fiords Wilderness:* is located immediately adjacent to the Project Area on its eastern boundary. Access from the Project Area is very limited due to extremely rugged alpine ridges forming the two areas' boundary. Mount Reid, the highest point on Revilla Island at 4,592-feet, is located on the Upper Carroll watershed boundary.

* ML=Modified Landscape, SV=Scenic Viewshed, LUD II=Legislated Primitive Area, W=Wilderness

Figure Recreation-1
Existing ROS Class Inventory Map



Direct and Indirect Effects of the Alternatives

Recreation Opportunity Spectrum (ROS)

With the exception of two areas, Neets Creek and Shelter Cove, the action alternatives will substantially change the ROS classes. The primitive area of Upper Carroll Creek would be roaded and harvested to different degrees by each of the alternatives. Alternatives 2, 5, and 6 enter this upper valley and change the ROS class from Primitive (P) to Semi-Primitive Non-Motorized (SPNM) and Roaded Modified (RM).

Most of the remaining proposed harvest in these action alternatives occur in areas classified as Roaded Modified due to harvest within the past 30 years or in SPNM areas immediately adjacent to these RM areas. With the action alternatives, these SPNM areas will change to RM.

Misty Fiords National Monument will not be physically impacted by any of the proposed alternatives of this EIS.

Figures Recreation-2 through Recreation-6 illustrate the changes in recreation settings. Other recreation places are not illustrated because there are no substantial changes to the ROS settings in these areas.

Table Recreation-3 displays the percent change in ROS Classes by alternative for the Project Area.

Table Recreation-3
ROS Classes by Alternative in Percent

ROS Class	Acres	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Primitive	15,252	33	0	16	0	0	33
Semi-Primitive NM	16,326	36	47	40	52	59	32
Roaded Modified	14,034	31	53	44	48	41	35
Project Area	45,612	100	100	100	100	100	100

SOURCE: GIS, Angelus 1996

Alternative 7 consists of proposed helicopter harvest near to existing harvested and roaded areas primarily in the lower reaches of the Carroll Creek area and near the Shelter Cove LTF. Alternative 3 converts the least amount of Primitive acres; Alternatives 2, 5 and 6 would eliminate all the Primitive recreation setting in the Project Area.

Table Recreation-4 displays the ROS class distribution by alternative. Primitive acreages represent areas inside the Project Area boundary that are connected to and part of larger Primitive areas outside the Project Area.

Table Recreation-4
ROS Class Acres Distribution by Alternative in Acres and Percent Change

		Roaded Modified		Semi-Primitive Non-Motorized		Primitive	
Alt.	Total Acres	Acres	Percent Change	Acres	Percent Change	Acres	Percent Change
Alt. 1	45,612	14,034	0.0	16,326	0.0	15,252	0.0
Alt. 2	45,612	24,098	+41.7	21,514	+24.1	0	-100.0
Alt. 3	45,612	18,422	+23.8	20,046	+18.6	7,094	-53.5
Alt. 5	45,612	21,944	+36.0	23,668	+31.0	0	-100.0
Alt. 6	45,612	18,611	+24.6	27,001	+39.5	0	-100.0
Alt. 7	45,612	15,603	+10.0	14,687	-10.0	15,252	0.0

SOURCE: GIS, Angelus 1996

In the action alternatives, roaded modified acres would increase the most in Alternative 2 and the least in Alternative 7. Semi-primitive non-motorized acres would increase the most in Alternative 6 and would remain the same in Alternatives 1 and 7. Primitive acres would remain the same in Alternative 7. Alternatives 2, 5, and 6 would completely eliminate the primitive ROS class, thereby displacing those recreationists seeking a pristine, remote recreation experience.

ROS Effects by VCU

Table Recreation-5 displays for each VCU the same information presented in Table Recreation-4 above. This table provides for the reviewer the opportunity to examine the specific changes projected for each VCU.

Table Recreation-5
ROS Class by Alternative for VCUs in Percent

		Alternative					
VCU	**ROS Class**	**Alt. 1**	**Alt. 2**	**Alt. 3**	**Alt. 5**	**Alt. 6**	**Alt. 7**
737 (9,178 Acres)							
	PRIM	0	0	0	0	0	0
	SPNM	38	26	38	29	38	38
	RM	62	74	62	71	62	62
744 (31,665 Acres)							
	PRIM	48	0	22	0	0	48
	SPNM	36	56	49	62	70	31
	RM	16	44	29	38	30	21
746 (4,769 Acres)							
	PRIM	0	0	0	0	0	0
	SPNM	27	25	25	26	26	27
	RM	73	75	75	76	74	73

SOURCE: GIS, Angelus 1996

One-hundred percent of the Primitive ROS class in the Project Area is found in VCU 744. Twenty-two percent of this natural setting (in VCU 744) would be retained through the implementation of Alternative 3. Sixty-two percent of VCU 737 and 73 percent of VCU 746 in the Project Area are classified as Roaded Modified ROS reflecting the bulk of past harvest activities in the Project Area beginning in the mid-1960s.

Use and Demand

Future recreation use and demand in the Project Area is expected to change with implementation of any of the alternatives. Existing recreation activities and patterns are associated with a combination of natural and roaded settings. The action alternatives generally would add to existing road networks.

As recreation settings change, recreationists will have several options. Some will find the conversion of some areas to roaded settings unacceptable and will either cease their activity or be displaced to other areas such as the Naha or Cleveland Peninsula. Some recreationists will adapt to the changes in the settings and continue to pursue traditional activities in the Project Area. Others recreationists will be attracted to opportunities within the roaded settings. Consequently, the use patterns are expected to change slightly.

Impacts of Alternatives on ROS Settings

All of the action alternatives would result in changes in the amount of nonroaded and roaded ROS settings found in the Project Area. Under Alternatives 2 through 7, there would be an increase in roaded ROS settings. As a result, there would be more accessible recreational activities such as access to freshwater angling and wildlife viewing along Carroll Creek. Conversely, there would be a reduction in areas with attributes associated with nonroaded settings. The effects of each alternative on ROS settings is discussed below.

The primary change from the existing condition, as a result of implementing action alternatives 2, 3, 5 and 6, would be a reduction in the Primitive ROS settings and an increase of RM and SPNM settings (see Figures Recreation-2 through Recreation-6). Alternative 7 retains all the Primitive setting while reducing slightly the SPNM setting.

Alternative 1

Alternative 1, the existing condition or no-action alternative, is used as the baseline for comparing the effects of the action alternatives on recreation. The existing condition is described in the preceding ''Affected Environment'' section.

Alternative 2

Alternative 2 proposes harvesting 72 units and constructing 61 miles of road. It would connect the Carroll Creek and Neets Creek drainages. Due to this road connection and a wide disbursement of harvest units, this alternative would eliminate the Primitive ROS setting. Correspondingly, there would be a 42 percent increase in the RM and 24 percent increase in the SPNM setting. Additionally, the existing continuous block of Primitive landscape setting, from the Naha river drainage to the Misty Fiords wilderness and Orchard Creek drainages would be interrupted. As a result, these large blocks of nonroaded landscape settings would be isolated.

Alternative 3

Alternative 3 would reduce 54 percent of the existing Primitive setting. Other than Alternative 7, this alternative reduces the least amount of such setting of all the action alternatives. No road connection is proposed between Neets Creek and Carroll Creek, nor would there be additional harvest and roads constructed in the Neets Creek drainage. Although the continuous block of primitive setting would be reduced, Alternative 3 would retain an undeveloped connection between the Naha, Orchard Creek, and Misty Fiords drainages. This alternative proposes 40 units and 21 miles of roads constructed. This development would be confined to those slopes east of Carroll Creek and south of the upper basin of Upper Carroll Creek.

Alternative 5

Alternative 5 would result in effects similiar to Alternatives 2, although no road connection is proposed. This alternative proposes 60 harvest units and 40 miles of roads. Roads and harvest units are proposed within the upper basin of Carroll Creek directly affecting the continuous block of Primitive setting with a 100 percent reduction in the Primitive ROS setting.

Alternative 6

Alternative 6 would result in effects similar to Alternative 5. However, roads and units are not proposed west of Carroll Creek. No road connection is proposed to the existing Neets road network; logging traffic would move south to Carroll Inlet. Forty-two harvest units and 19 miles of road are proposed. With this alternative, the continuous Primitive block would be reduced by 100 percent, with the RM and SPNM settings increasing by 25 percent and 40 percent respectively.

Alternative 7

Alternative 7 proposes mostly helicopter harvested units in VCU 744 in those areas immediately adjacent to and on the east slopes above the open floodplain and estuary of Carroll Creek. Twenty-four harvest units are proposed. Because of the absence of new roads, the continuous Primitive block in the upper Carroll Creek basin would not be reduced. The RM setting would increase by ten percent and the SPNM setting would be reduced by 10 percent.

Figure Recreation-2
Upper Carroll ROS-Class for Alternative 2

Figure Recreation-3
Upper Carroll ROS-Class for Alternative 3

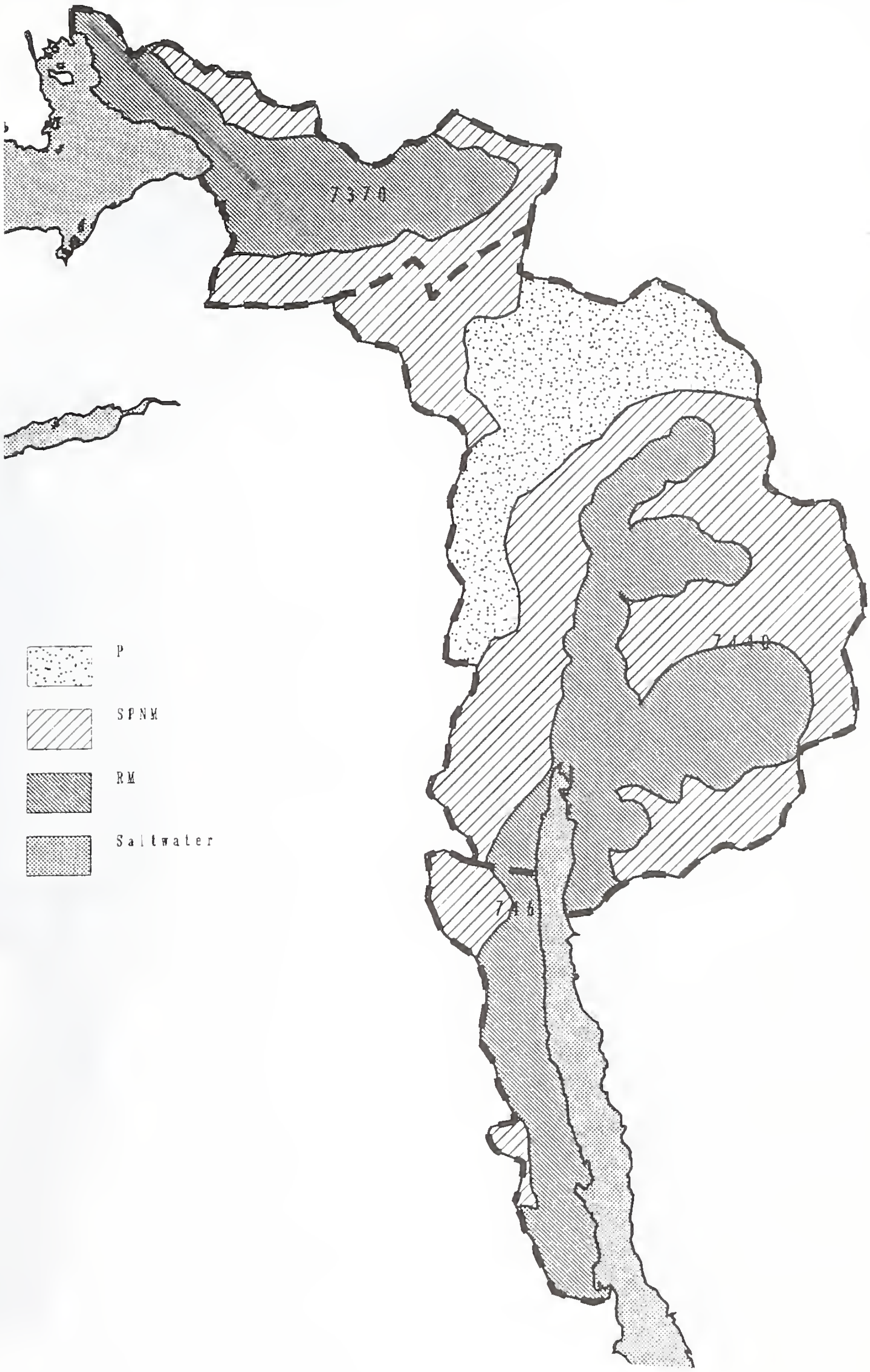


Figure Recreation-4
Upper Carroll ROS-Class for Alternative 5

Figure Recreation-5
Upper Carroll ROS-Class for Alternative 6

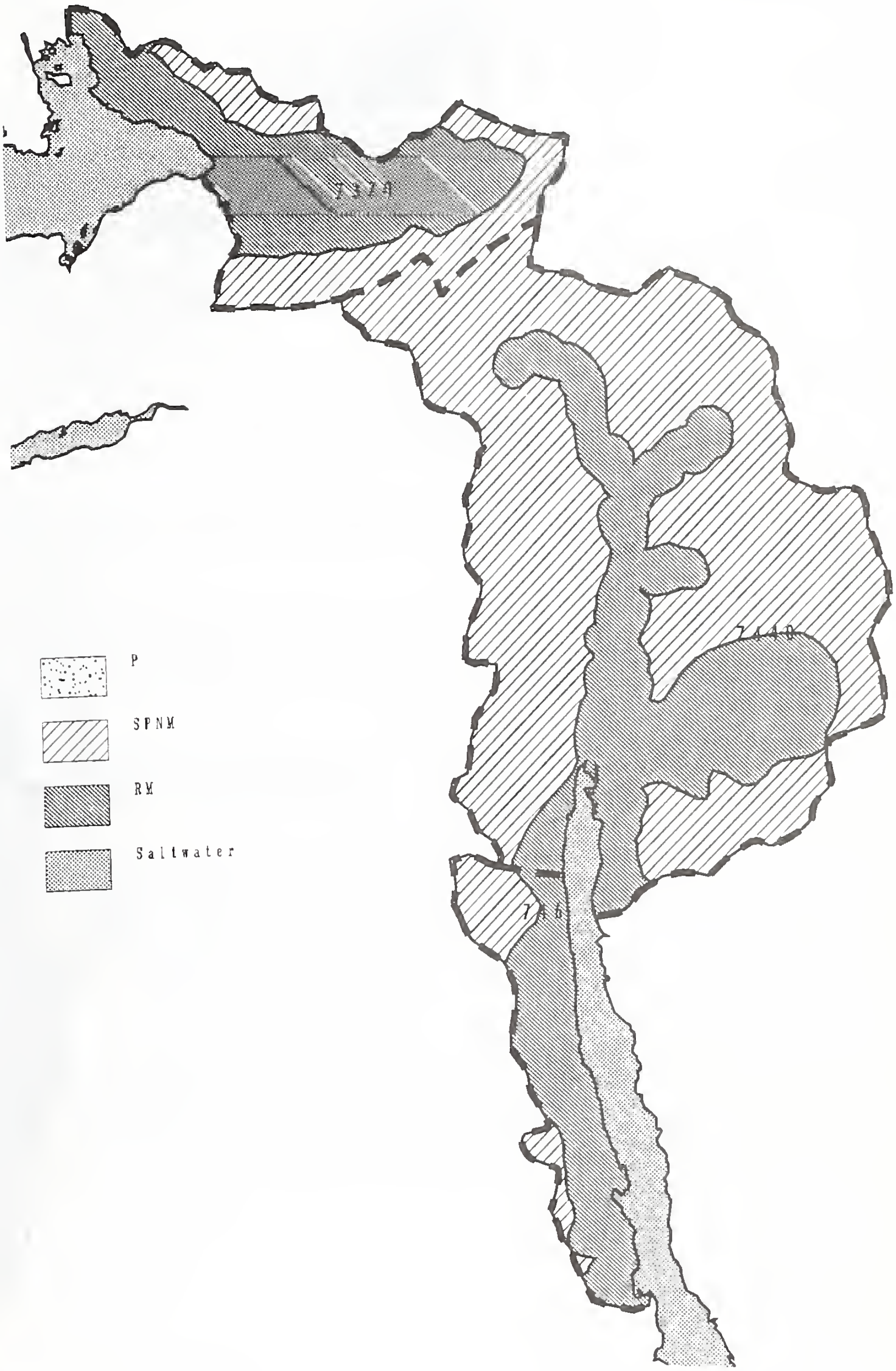
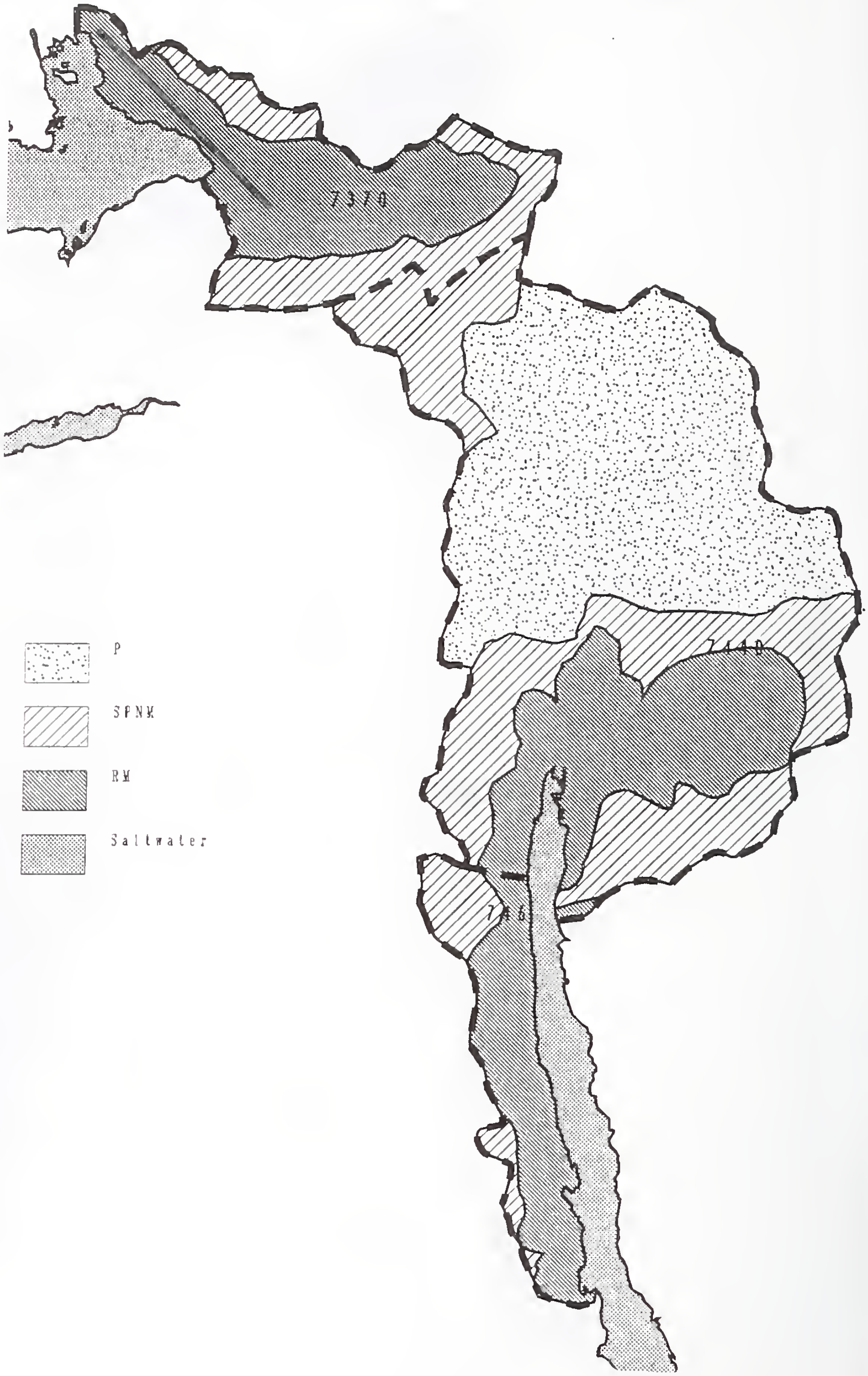


Figure Recreation-6
Upper Carroll ROS-Class for Alternative 7



Recreation Places and Sites

Because data on the number of recreationists who recreate in remote areas such as the Project Area is very limited, it is difficult to estimate how the alternatives would affect users of an area. Because of noise, visual impacts, and the resulting change in the recreational setting, many existing recreation activities are incompatible with an active logging operation. Recent analysis by the Forest Service has concluded that approximately 50 percent of the current activities occurring in recreation places rely on the natural appearance of the area (Forest Service 1990b). If a recreation place is entered for timber harvest, those activities that are incompatible will cease until the area returns to a natural setting.

The adjacent Recreation Places and Sites in Misty Fiords National Monument, the Naha, and within the Orchard Creek drainage will maintain their Primitive setting. Saddle Lakes and the Shelter Cove area will continue to be affected by ongoing timber harvest and roading activities, though the former to a much lesser degree. The other Recreation Places within the Project Area which are now RM will continue to move toward the SPNM setting as second-growth continues to mature and old roads are overtaken by first alder then gradually spruce, hemlock, or cedar.

An indirect effect of the action alternatives may be increased recreational and subsistence use in the vicinity of the logging camps and areas. This increased use would be predominately hunting, fishing, and gathering of forest products.

Another indirect effect would be noise from logging operations. The noise would occur from logging and road building activities, and from the logging camps. Because of this, the anchorages at Neets Bay and Carroll Inlet may not provide the desired recreational experience.

Throughout the Project Area, people may use the road systems for recreation after harvesting has been completed. These users may place increased pressure on the fish and wildlife resources. However, this use may diminish over time as alder slowly closes the roads to foot and ATV traffic.

Cumulative Effects

By the year 2140, the recreation settings in the Project Area will move toward an emphasis on Roaded Modified and Roaded Natural ROS classes. Existing recreation place settings will reflect this change, and new recreation opportunities associated with roads will likely be present. Although a connected road network to the City of Ketchikan from the Project Area and points north is probably not a reasonably foreseeable event (within 10 years), it would be safe to assume such a network would be in place by the year 2140.

Recreation users with high expectations for natural appearing settings will have adapted to the changing conditions, or have been displaced to other areas on the Forest, or will choose to no longer recreate on the Forest. Displacement to other natural areas may result in increased use, social encounters, and a reduction in the opportunities for solitude in those places. These changes are consistent with the analysis and projections in the TLMP RSDEIS (1996a).

Wild and Scenic Rivers: Affected Environment

Rivers on the Tongass National Forest were evaluated in the TLMP Revision as to their eligibility for the National Wild and Scenic Rivers System. To be eligible, a river must be free-flowing, and contain at least one "outstandingly remarkable value." One river near the Project Area, Orchard Creek and Lake, was found eligible for a classification of "wild". The river was further studied as to its suitability for inclusion in the National System in the TLMP Revision SDEIS, Appendix E. Orchard Creek was not recommended for inclusion to the National Forest System in the Preferred Alternative of the TLMP RSDEIS (1996a).

Carroll Creek and Neets Creek were determined not to contain outstandingly remarkable values representative of the resource or geographic province (TLMP 1991a, p.3-447). This evaluation was not changed as part of the TLMP RSDEIS (1996a).

Wild and Scenic Rivers: Effects of Alternatives

None of the alternatives affect the eligibility of Orchard Creek and Lake for consideration as a Wild and Scenic River. The potential Wild River classification would remain.

Roadless Areas: Affected Environment

The Upper Carroll Project Area includes portions of the No. 526 North Revilla Roadless Area (141,779 National Forest acres; 32,245 Project Area acres) and the No. 524 Revilla Roadless Area (104,998 National Forest acres; 2,168 Project Area acres), as identified in the TLMP Revision, (1991a). This analysis evaluates the direct and indirect effects the alternatives may have on the roadless character and wilderness attributes of these two areas.

Roadless Areas are defined as areas in a National Forest or grassland that meet minimum wilderness criteria, as defined by the 1964 Wilderness Act and its implementing regulations. These are roadless areas that have been identified in the TLMP RSDEIS planning process and not by the Roadless Area Review and Evaluation II (RARE II) process.

The minimum criteria for considering a roadless area in the evaluation of Wilderness potential was established by the Wilderness Act of 1964, and in subsequent regulation and policies. To qualify, an area must contain at least 5,000 acres of undeveloped land which does not contain improved roads maintained for travel by passenger-type vehicles. However, areas less than 5,000 acres may qualify if they are a self-contained ecosystem such as an island, are contiguous to existing Wilderness, or are ecologically isolated by topography and manageable in a natural condition.

Once an area is roaded it is generally no longer available for Wilderness consideration. Roadless Areas are described in Appendix C of the TLMP Revision (1991a). Roadless areas within the Upper Carroll Project Area are described below.

North Revilla Roadless Area No. 526

The North Revilla Roadless Area totals 141,779 acres of which 32,245 acres (or 22.7 percent) are within the Project Area. This roadless acreage includes all of the unroaded portions of the Carroll Creek and Neets Creek watersheds. The majority of the Neets Creek drainage has been extensively roaded and harvested. The remaining unroaded portions of the Neets Creek drainage consists of very steep, rugged terrain with many V-notches and landslide paths. These unroaded areas, because of their small size and fragmented nature, do not meet criteria for consideration for wilderness.

Nearly all of the Carroll Creek drainage remains roadless except for the very southeastern portion adjacent to Carroll River estuary. The major portion meets the criteria for consideration as a wilderness area because of its intact natural integrity, high scenic quality and high quality primitive recreation opportunities.

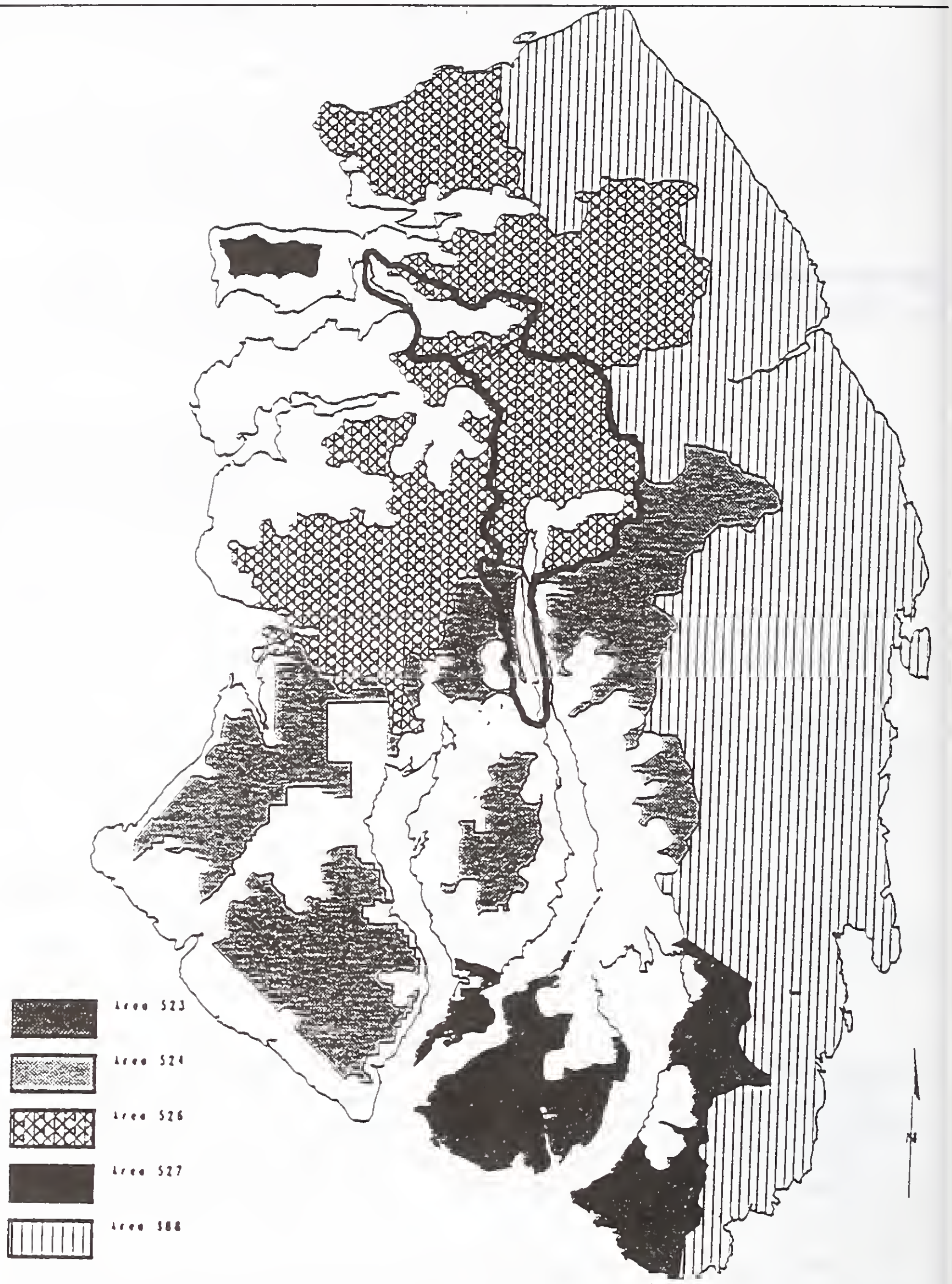
Revilla Roadless Area No. 524

The Revilla Roadless Area is 104,998 acres of which 2,168 acres (or 2.1 percent) are within the Project Area. This area, characterized by rugged terrain, steep mountain slopes, and numerous lakes, is located on the southwest quarter of Revilla Island. This area is the source of Ketchikan's hydropower that comes from the Swan Lake power generation facility.

The area has been modified by human activity connected to its close proximity to Ketchikan. There is opportunity for solitude within certain parts of the area, but aircraft noise can be heard virtually everywhere. Owing to extensive road networks from previous timber harvest, there are many semi-primitive attractions available. Because of these factors, Roadless Area 524 does not meet the criteria for consideration for wilderness.

Figure Recreation-7 displays the roadless areas within the Project Area.

Figure Recreation-7
Upper Carroll Project Area Roadless Areas



The Project Area includes portions of the North Revilla (526) and Revilla (524) Roadless Areas.

Roadless Areas: Effects of the Alternatives

All action alternatives would affect the roadless character and roadless attributes of the Project Area to varying degrees.

In all action alternatives, timber harvest and road construction would directly and indirectly affect the North Revilla (526) and Revilla (524) Roadless Areas. The following discussion summarizes the areas where the alternatives differ as to their effects on roadless acreage.

North Revilla Roadless Area No. 526

Carroll Creek Drainage

In the Carroll Creek drainage, which is already roaded by past harvest in its lower portion, Alternatives 2, 3, 5, and 6 propose roading and harvest units several miles up into the drainage, thereby reducing the roadless acreage in this portion of the Roadless Area. Alternative 7 is unique in that it proposes only helicopter harvest in this Area, and as such, does not affect the roadless classification.

Neets Creek Drainage

In the Neets Creek drainage, also roaded by past harvest, Alternatives 2 and 5 propose additional roading and harvest on the higher slopes of this valley, thus slightly decreasing the roadless acreage remaining in this portion of the North Revilla Roadless Area. The proposed helicopter harvest acres do not reduce roadless acres. Alternatives 3, 6, and 7 propose no additional harvest in this drainage.

Revilla Roadless Area No. 524

Shelter Cove Area

All action alternatives propose additional timber harvest and roads in this area. Extensive harvest and road networks associated with that harvest have occurred in the past. This area has high potential for development of roaded recreation which is a priority objective for Ketchikan area residents. Plans include extending the Ward Lake road from Harriet Hunt Lake into the upper end of George and Carroll Inlets; the first proposals are to connect to Saddle Lakes immediately adjacent to the Project Area near the Shelter Cove Log Transfer Facility (LTF).

Table Recreation-6 displays by alternative the number of roadless acres remaining in each roadless area within the Project Area.

Table Recreation-6
Remaining Acres of Roadless Areas within the Project Area by Alternative

Alternative	North Revilla 526	Revilla 524	Total Acres	Percent Change
1	32,245	2,168	34,413	0.0
2	22,946	1,979	24,925	-27.6
3	28,049	2,168	30,217	-12.2
5	25,272	2,168	27,440	-20.3
6	27,786	2,168	29,954	-13.0
7	32,245	2,168	34,413	0.0

SOURCE: GIS, Angelus 1996.

Action alternatives 2, 3, 5, and 6 would reduce the roadless acres within the North Revilla Roadless Area No. 526. Reductions would range from 4,196 acres in Alternative 3 to 9,488 acres in Alternative 2. Some of these reductions are in drainages that are already logged and roaded, but represent new acreage reductions. Due to harvest by helicopter and no new road construction in previously unroaded areas, Alternative 7 would not reduce roadless acres. None of the action alternatives affect the potential for wilderness designation for other drainages in Roadless Area No. 526 outside the Project Area.

In the Revilla Roadless Area No. 524, only the Alternative 2 proposal would further reduce roadless acres (by 189 acres). Alternatives 3, 5, 6, and 7 propose new harvest within areas already classified as roaded.

Roadless Areas: Cumulative Effects

By the year 2140, there will be few roadless areas remaining in the Project Area except for the upper parts of the drainages and ridges that cannot be logged due to physical limitations. The following figures (Recreation-8 through Recreation-11) display the effects of the action alternatives on Roadless Area 526.

Figure Recreation-8
Roadless Area Changes For Alternative 2

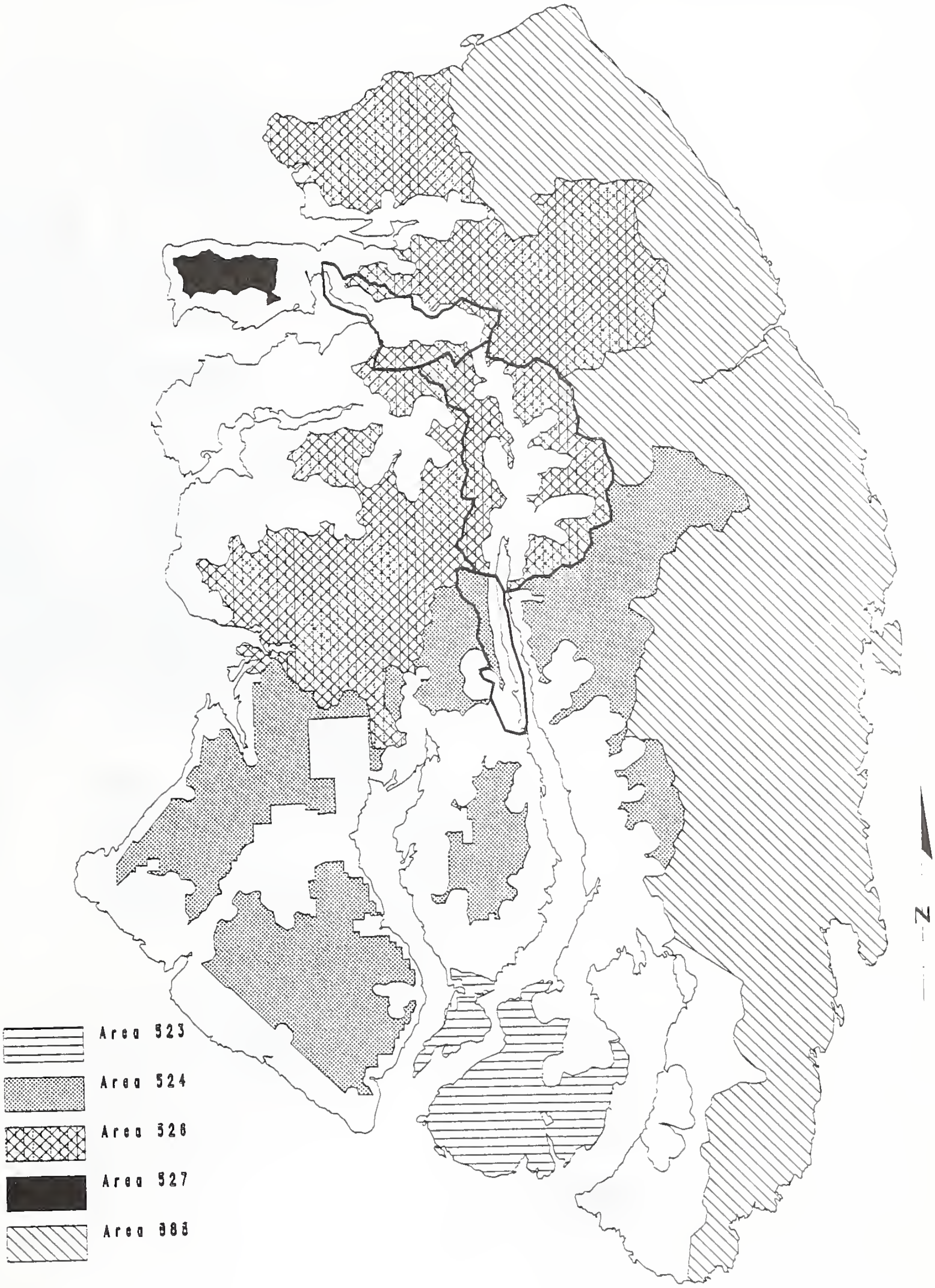


Figure Recreation-9
Roadless Area Changes For Alternative 3

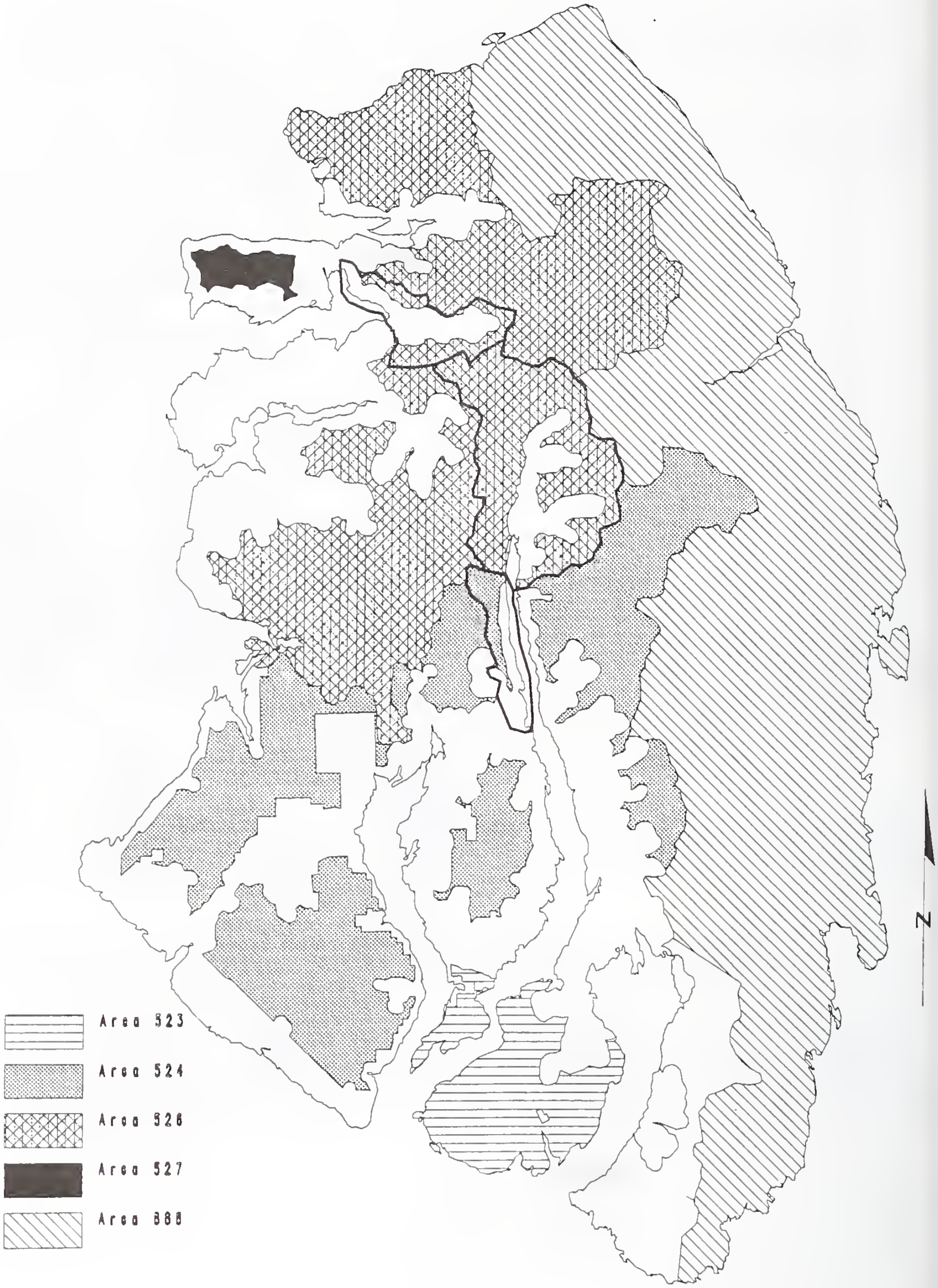


Figure Recreation-10
Roadless Area Changes for Alternative 5

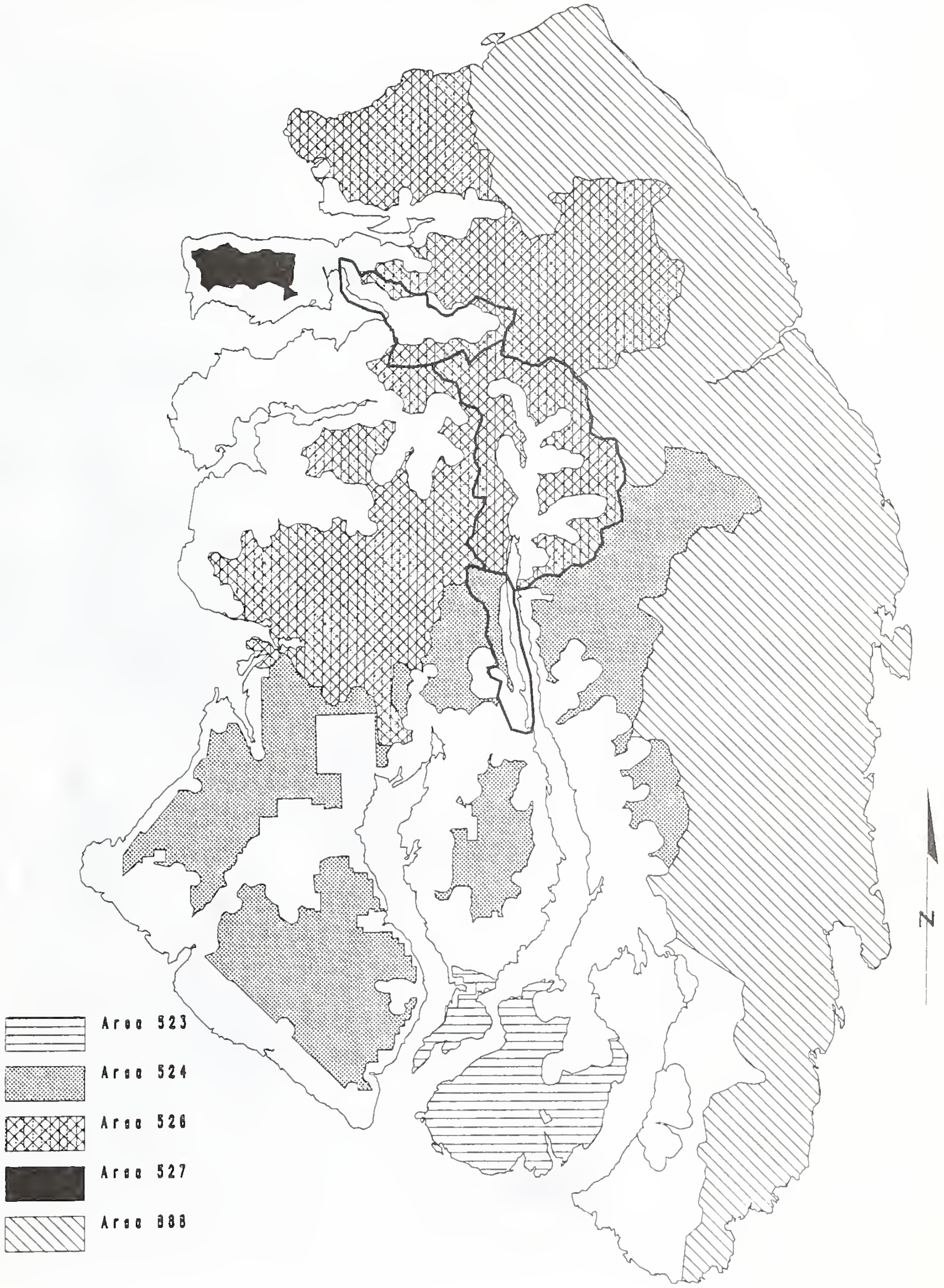


Figure Recreation-11
Roadless Area Changes for Alternative 6

Scenic Resources

Key Terms

Cumulative Visual Disturbance (CVD)—the sum of all scenic effects created by all landscape alterations that are visible at a given point in time.

Distance Zones

Foreground—the detailed landscape found within 300 feet to one-half mile from observer.

Middleground—the space between foreground and background in a picture or landscape. The area, located from one-half to 4 miles from the viewer; often the most critical zone for scenery management; form, texture, and color remain dominant, and pattern is important.

Background—the distant part of a landscape; from 4 miles to the horizon from the viewer; line, form and pattern are the dominant visual characteristics.

Visual Condition (VC)—a measure of the magnitude of human-caused deviations in form, line, color, and texture from attributes of the natural or natural-appearing landscape. Visual condition is used to describe an existing situation, a desired future condition, or an objective for management.

Unaltered—the natural condition.

Imperceptibly altered—management activities are not visually evident to the casual forest visitor.

Slightly altered—management activities may be evident, but must remain visually subordinate to the natural or natural-appearing landscape character.

Moderately altered—management activities may dominate the landscape character, but at the same time, appear as a natural occurrence when viewed in the middleground or foreground zone.

Heavily altered—management activities may dominate the landscape character, but should appear as a natural occurrence when viewed as background.

Drastically altered—human-caused deviations that glaringly dominate the natural or natural-appearing landscape.

Existing Visual Condition (EVC)—the level of scenic quality or condition presently occurring on the ground.

Future Visual Condition (FVC)—the level of scenic quality or condition occurring on the ground at the end of the proposed harvest period.

Visual Quality Objective (VQO)—management direction that sets measurable limits on degrees of human-caused alterations and management activities; is based on a landscape's diversity of natural features and the public's sensitivity for high scenic quality.

Sensitivity level—the measure of people's sensitivity for scenic quality; three levels are assigned to land areas viewed from boat routes, anchorages, plane routes, roads, trails, public use areas, and recreation cabins.

Viewshed—a distinct area of land visible from travelways (boat route, recreation road, or trail) or use areas (recreation cabin, anchorage).

Visual Absorption Capacity (VAC)—an estimate of the relative ability of a landscape to absorb management activities.

Affected Environment

Introduction

An important aspect of Southeast Alaska's natural resource base is its attractive setting. The importance of this scenic splendor of the area is evident by increased tourism and a heightened awareness of and sensitivity to visual resource values by Alaska's residents. The Visual Management System (VMS), developed by the Forest Service in 1976 inventories these visual resources and provides measurable standards for their management.

The VMS manages the visible aspects human activities which occur upon the land. It provides an overall framework for the orderly inventory, analysis, and management of scenery (Landscape Aesthetics: A Handbook for Scenery Management 1995, Draft). The system applies to every acre of National Forest System lands and all activities administrated by the Forest Service.

The visual resource inventory is a two-part analytic process. The first part assesses the relative scenic quality (Landscape Character Type and Variety Class) of the landscapes in the Project Area. The second part assesses viewer sensitivity levels based on visibility and the viewers use of these landscapes.

Utilizing the information from the visual resource inventory integrated with other resource concerns and considering management concerns, a set of management goals are established, known as Visual Quality Objectives (VQOs).

The following discussion applies the Visual Management System to the Upper Carroll Project Area.

Landscape Character

Landscape character is an overall visual impression of landscape attributes—the physical appearance of a landscape that gives it an identity and ''sense of place.'' Landscape character gives a geographic area its image.

The terrain in the Project Area is typical of the Coastal Hill landscape character type. It consists of deeply dissected blocks of high mountains two to three miles across, separated by deep fjords or valleys one-half to three miles wide. The closely spaced mountainous ridges top out at over 4,500-foot elevations. Generally, steep landforms to saltwater (Neets Bay and Carroll Inlet) or stream bottoms (Neets Creek and Carroll Creek) and an irregular rounded appearance are characteristic.

Scenic Quality

The first step in the landscape analysis process assesses the inherent scenic value of all landscapes in the analysis area as they are found in their natural state. These landscapes are rated as having either distinctive, average, or low scenic attractiveness (Classes A, B, and C). Landscapes ranking high in scenic value are usually those of above average variety. These ratings are based on the degree of diversity in the physical features and are rated relative to the overall character of the larger region, the Coastal Hill character type.

Mostly Class B landscapes are found within the Project Area, although two areas, the Carroll Creek estuary and the upper portion of the Carroll Creek, rate as Class A, or distinctive, within the context of this Project Area.

Sensitivity Level Inventory

The second part of the landscape analysis identifies recreation use areas, communities, travel routes (marine and land), anchorages and cabins, and their associated viewsheds. These visually sensitive areas are based on their type and frequency of use, and range from Sensitivity Level I to Level III.

A Sensitivity Level I is assigned to viewsheds associated with heavily used recreation areas and major marine travel routes. Sensitivity Level II is assigned to areas such as less frequently used boat routes, roads, anchorages, salt water fishing areas, and their viewsheds. Sensitivity Level III applies to all land areas not seen from any of the Level I or II travel route or use areas.

The key sensitive use areas within the Project Area are classified into two categories—saltwater and inland recreation areas.

Saltwater

The Neets Bay area near Ketchikan from Behm Canal to the head of the bay at the fish hatchery (41 miles from Ketchikan) is inventoried as Level II. This corridor is used extensively by local sport/commercial fishing boats and charters from nearby Yes Bay Lodge. Carroll Inlet, from near Mountain Point to the Carroll Creek estuary near Swan Lake Creek, is a popular sport/commercial fishing and hunting area just 32 miles from Ketchikan and is also inventoried as sensitivity level II.

Inland Recreation Areas

The inland areas along Carroll Creek and Neets Creek are Sensitivity Level III. Only some alpine areas of the Project Area can be seen from both Orchard Lake and Orchard Creek and the Misty Fiords National Monument and, as such, are Level I.

Visual Quality Objectives (VQOs)

VQOs are a set of measurable goals for management of scenic resources on National Forest System lands. They are standards established in the planning process, and are based on an evaluation of variety classes, view sensitivity levels, distance zones, integration with other resources, and consideration of management goals.

The VQOs describe different degrees of acceptable alteration of the natural landscape. They include Preservation (P), Retention (R), Partial Retention (PR), Modification (M), and Maximum Modification (MM), and are defined in the Glossary.

Existing and Future Visual Condition

As part of the planning process for the Upper Carroll Project Area, a detailed visual analysis has been completed. Field visits, topographic map analyses, and computer-generated perspective views or plots were used to determine the visual impacts of the various alternatives. All seen or viewed areas in the Project Area were digitized, natural openings and existing harvest areas were plotted, and computerized terrain and view models were created for each viewpoint. VCUs 737, 744, and 746 were analyzed. Analysis from VCU 734 to the other VCUs were studied for any apparent landscape alterations as seen from the Orchard Lake and Creek viewshed.

As part of the planning process for the Upper Carroll Project Area, a detailed visual analysis has been completed. Field visits, topographic map analyses, and computer-generated perspective views or plots were used to determine the visual impacts of the various alternatives. All seen or viewed areas in the Project Area were digitized, natural openings and existing harvest areas were plotted, and computerized terrain and view models created for each viewpoint. VCUs 737, 744, and 746 were analyzed. Analysis from VCU 734 to the other VCUs were studied for any apparent landscape alterations as seen from the Orchard Lake and Orchard Creek viewsheds.

Existing Visual Condition (EVC) represents the degree of visual modification or disturbance presently occurring on the ground. Similarly, Future Visual Condition (FVC) represents the visual condition level that would occur at the end of a proposed activity period (including what presently exists). Both are measured in terms of condition types as described below (Levels I - VI. Existing and future visual condition levels may also be described in terms similar to those used to describe VQOs. Additionally, visual modification levels of viewsheds can be described in a similar manner.

Level I — **Unaltered**
Areas in which only ecological change has taken place. Corresponds to the Preservation VQO

Level II — **Imperceptibly Altered**
Areas in which changes in the landscape are not noticeable unless pointed out; natural-appearing; corresponds to the Retention VQO; viewshed in which no more than 10 percent of the area seen is visually modified.

Level III — **Slightly Altered**
Areas in which changes in the landscape are noticed, but do not attract attention; Corresponds to the Partial Retention VQO; viewshed in which no more than 20 percent of the area actually seen is visually modified.

Level IV — **Moderately Altered**
Areas in which changes in the landscape are easily noticed and may attract attention; Corresponds to the Modification VQO; viewshed in which no more than 25 percent of the area actually seen is visually modified.

Level V — **Heavily Altered**
Areas in which changes in the landscape obviously appear to be major disturbances and stand out as a dominating impression of the landscape; Corresponds to the Maximum Modification VQO; viewshed in which no more than 50 percent of the area actually seen is visually modified.

Level VI — **Drastically Altered**
Areas in which changes in the landscape are in glaring contrast to a natural appearance; an unacceptable visual condition; not a VQO

The EVC benchmark inventory can be used to: (1) compare a viewshed's actual condition (current degree of alteration) with a project's proposed VQOs, (2) assess cumulative visual impacts of alternatives, and (3) determine whether the proposed management activities or facilities will maintain or change the present conditions, lower the scenic quality, or meet/not meet a project's proposed VQOs.

Project Area Viewsheds

Viewsheds differ from watersheds or VCUs in that viewshed boundaries are defined only by visible areas actually seen from representative viewpoints. The primary viewing platform in the Project Area is from saltwater. Sample viewpoints are positioned a minimum of one-quarter to one-half mile from the shoreline. Typically, the foreground distance zone is composed of beach fringe vegetation which acts to screen some landscape from view.

To assess the potential visual impacts of the different alternatives in relation to this EIS's proposed VQOs, a set of travel routes and use areas considered important (related to the Sensitivity Level I and II areas) to the Upper Carroll Project Area and their associated viewsheds has been identified. These viewsheds are divided into three categories based on their present visual condition: (I) unaltered, (III) slightly altered, and (IV) moderately altered.

Table Scenic-1 lists each viewshed by its name and existing visual condition level. Locations of these viewsheds are indicated by viewpoint direction symbols in Figure Scenic-1.

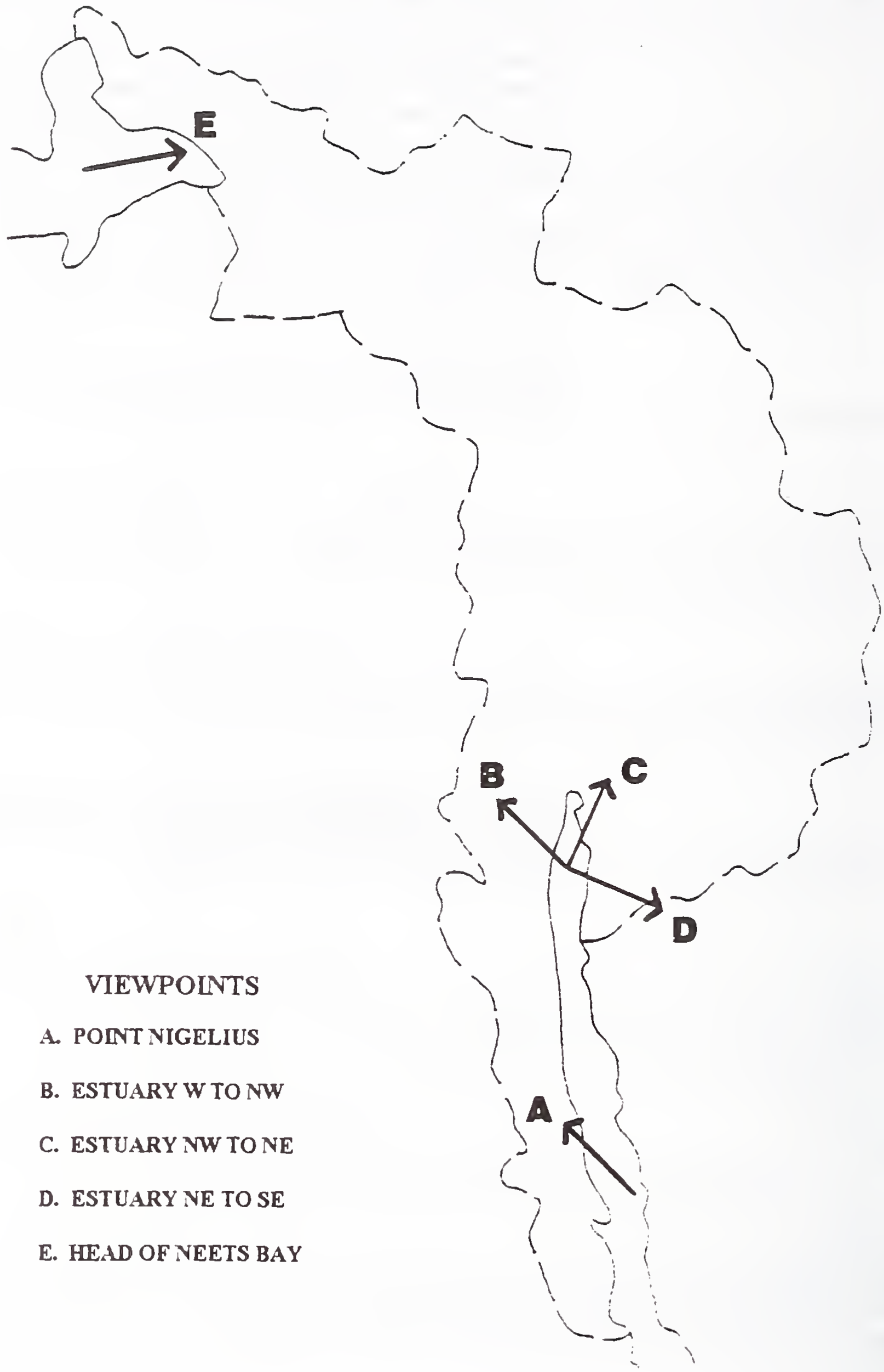
Table Scenic-1
Project Area Viewsheds, by Name and EVC

Unaltered	Slightly Altered	Moderately Altered
Carroll Estuary W-NW	Point Nigelius	Shelter Cove
	Carroll Estuary NE-SE	Carroll Estuary NW-NE
		Head of Neets Bay

SOURCE: Angelus 1996 and Ketchikan Area Visual Resource Inventory

Thirty viewpoints (ground level and aerial) were established for analysis in this EIS, of which only six have been selected for analysis (one for each associated viewshed) and are illustrated in Figure Scenic-1 on the following page.

Figure Scenic-1
Project Area Photopoints - Location Map



Project Area Visual Objectives

Each viewshed's EVC and proposed VQOs are compared in Table Scenic-2. These proposed VQOs are consistent with those proposed in the TLMP Draft Revision.

Table Scenic-2
Comparison of Visual Condition and VQOs by Viewshed

Viewshed Name	Existing Visual Condition	Inventory VQOs	Proposed VQOs (Foreground and Middleground)
Carroll @ Shelter Cove	moderately altered	M	PR-M
Carroll @ Nigelius Point	slightly altered	PR	PR-M
Carroll Estuary W-NW	unaltered	P	PR-M
Carroll Estuary NW-NE	moderately altered	M	PR-M
Carroll Estuary NE-SE	slightly altered	PR	PR-M
Head of Neets Bay	moderately altered	M	PR-M

SOURCE: GIS, Angelus 1996

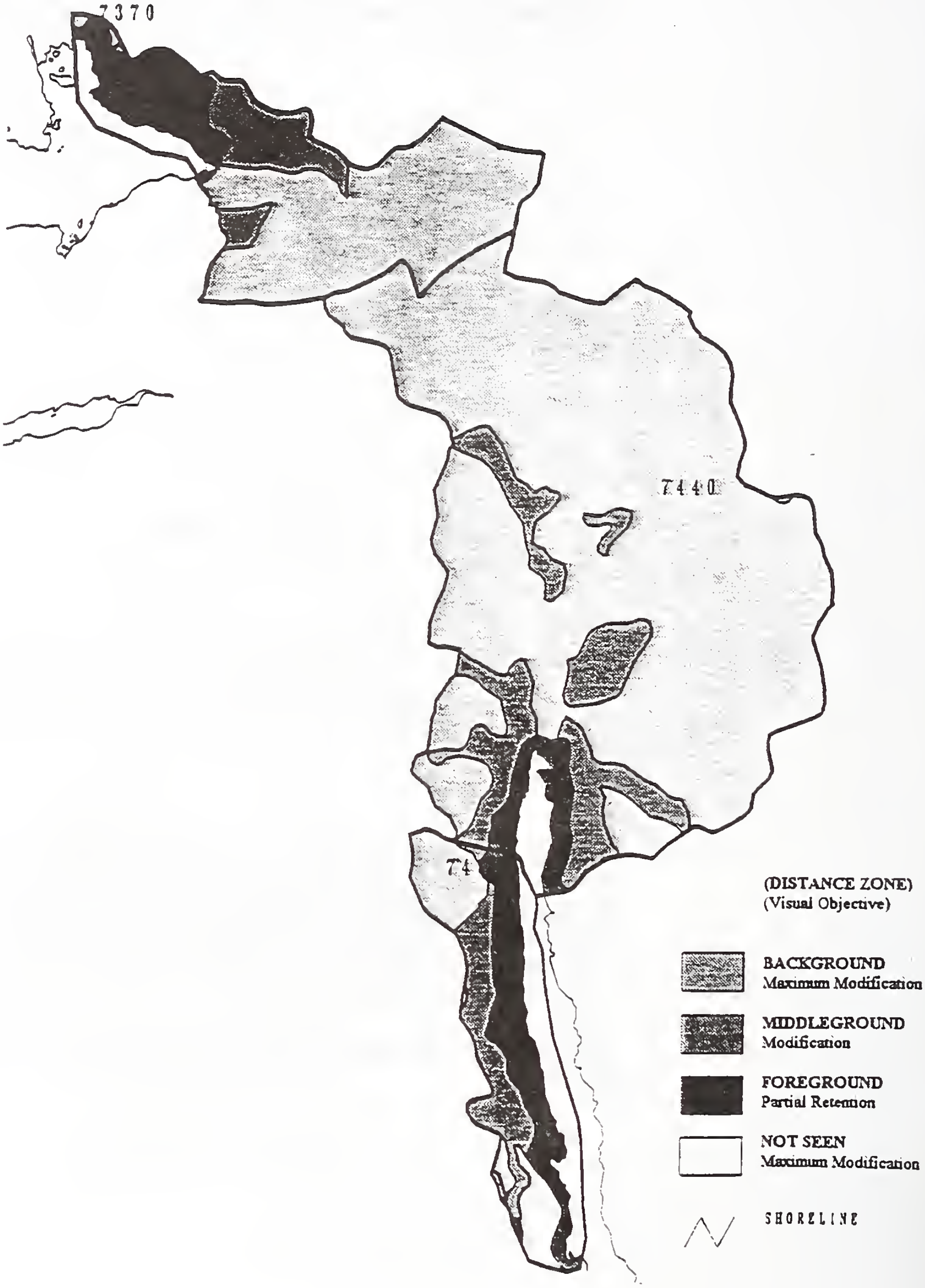
Note: P= Preservation; R = Retention VQO; PR = Partial Retention VQO; M = Modification VQO; FG = Foreground; MG = Middleground

All viewsheds are viewed from one-quarter to one-half mile from saltwater shorelines. There are no background areas within these viewsheds (greater than 5 miles). All unseen areas are proposed to be managed for the Maximum Modification VQO.

There are 11,328 visible acres (or 25 percent) within the Project Area, of which 764 seen acres (or 7 percent) of the viewsheds has been harvested since the middle 1950s. Although the majority of second-growth is 20-30 years old and 25-40 feet high, it is still noticeable when viewed as foreground due to variations in topography, harvest unit shape and location, and mature-stand backline edge contrasts. Vegetation texture and color differences account for definitive edge separations as well.

The following map, Figure Scenic-2, Project Area VQOs, illustrates the visible terrain in the Project Area.

Figure Scenic-2
Upper Carroll Project Area VQOs



Effects of the Alternatives

Individual Viewsheds

The following discussion will cover the visual impacts of the proposed action alternatives within four viewsheds. Each viewshed's discussion includes perspective plots depicting the alternative with the most proposed visual disturbance (except the Shelter Cove and Point Nigelius viewsheds; changes between the DEIS and FEIS eliminated most visual impacts). Visible harvest units and roads will be noted. See Figure Scenic-1 for the location and orientation of the viewshed photopoints.

The discussion order is geographically northward from the Shelter Cove area of Carroll Inlet, Carroll River estuary, then to the head of Neets Bay.

Carroll Inlet at Shelter Cove Viewshed

This 1,466-acre saltwater viewshed is the first in the Project Area encountered while boating north from the Revilla Channel near Ketchikan. It is adjacent to the Saddle Lakes recreation area (future) and the Naha Roadless Area. The landscape character consists of an area one-half to one mile in width with less than 25 percent slopes on interspersed hills and knobs. In the middleground, the landform then rises to 2,500-foot ridgetops.

Currently, this viewshed meets both the Partial Retention VQO and Modification VQO.

Alternative 1 - No Action

The EVC of this viewshed is moderately altered (Level IV) from an existing 52 seen acres of timber harvest and logging transfer facility. Left unchanged, the FVC would remain the same except for a change in tree height, color, and texture.

Alternatives 2, 3, 5, 6 and 7

The five action alternatives, except Alternative 6, propose from one to three harvest units totaling one to ten visible acres. This harvest will occur adjacent to existing alterations or on middleground slopes more than one mile distant. Although there is an active LTF onshore immediately in the foreground, the proposed additional harvest would not add appreciably to visual contrasts. All proposed harvest in all alternatives would meet the VQOs. However, visible foreground rock pits and road cut-and-fill slopes may not meet the VQOs. The FVC would remain the same except for a change in tree height, color, and texture.

Due to insignificant visible harvest effects, there is no perspective plot shown for this viewshed.

Carroll Inlet at Nigelius Point Viewshed

This 2,295-acre saltwater viewshed is essentially the western shoreline of Carroll Inlet from Nigelius Point north of Shelter Cove to the slopes opposite the Swan Lake power plant and picnic shelter. Heavily forested slopes rise sharply from saltwater to 3,100-foot alpine ridges (forming the eastern boundary of the Naha roadless area). The Swan Lake powerline and its cleared right-of-way (ROW) are visible horizontally across the viewframe. Although the ROW clearing is somewhat visible, there is enough greenup from vigorous second-growth to mitigate apparent visual contrasts.

Currently, this viewshed meets the proposed VQOs of Partial Retention in the foreground and Modification in the middleground.

Alternative 1 - No Action

The EVC of this viewshed ranges from slightly (Level III) to moderately altered (Level IV). Left undisturbed, the FVC would remain the same except for a change in tree height, color, and texture.

Alternative 2

The DEIS proposed two contiguous harvest units, Unit 123 and Unit 124, in Alternative 2, totaling 36 acres. These harvest units were dropped from further consideration in the FEIS to mitigate potential damage to the existing Swan Lake powerline from helicopter harvest operations. This harvest would have occurred above and behind the powerline that parallels the shoreline. In addition, the visual impact of harvesting these two units would not have met the Partial Retention VQO. The units' shape, size, and scale would have clearly dominated this viewshed and would have been very noticeable from as far south as Shelter Cove and as far north as Carroll Estuary and beyond. The visual impact to recreational users of the State of Alaska Picnic Shelter at the Swan Lake Outlet facility would have been in dramatic contrast to the terrain's natural scenic features.

Because of these changes, there is no perspective plot shown for this viewshed.

Alternatives 3, 5, 6 and 7

There are no proposed harvest units and roads in these alternatives for this viewshed.

Carroll Inlet at Carroll Creek Estuary NW, NE, and SE Viewsheds

Located at the head of Carroll Inlet, this 5,174-acre saltwater viewshed consists of a deeply incised canyon with extensive, older harvest in evidence along the right side or eastern slopes of a one-half-mile wide valley straddling the Carroll River and surrounding the estuary.

Three photopoints were studied from one location just south of the tidal flats of the estuary. This location is near an existing LTF on the eastern shore. Due to the wide flat-bottom nature of this viewshed, and east-west oriented ridges and valleys that join Carroll Creek valley, most visible terrain is of the immediate foreground (steep slopes bracketing Carroll estuary) and distant middleground slopes northwest, north, and northeast above Carroll Creek valley.

Each of the three photopoints define sub-viewsheds and are described below.

Carroll Estuary W to NW Viewshed

Alternative 1 - No Action

This photopoint views those slopes and shoreline in a northwesterly direction. This heavily vegetated steep hillside is in an unaltered state (Level I) and meets the Partial Retention and Modification VQOs. Left undisturbed, the FVC would remain the same, except for changes in tree height, color, and texture.

Alternatives 2 and 7

Alternatives 2 and 7 propose three roaded harvest units in the middleground of this sub-viewshed. Unit 1 at 38 acres, Unit 18 at 43 acres, and Unit 90 at 10 acres would readily be seen from this vantage point. Ninety-one visible acres are proposed, although the VQOs of Partial Retention and Modification would be met from this photopoint, primarily due to vegetative and topographic screening.

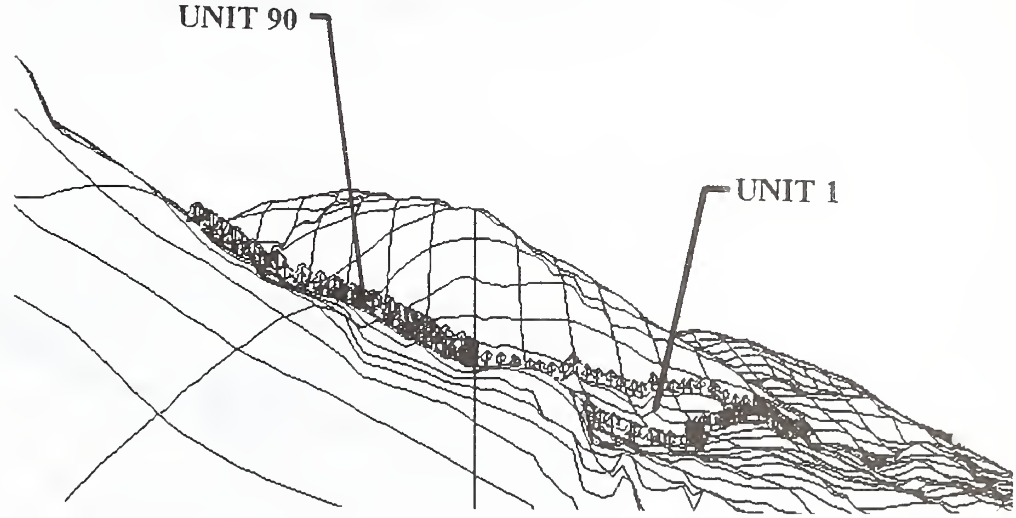
Alternatives 3, 5, and 6

There are no proposed harvest units and roads in these alternatives for this viewshed.

Figure Scenic-3 below illustrates the topographic terrain features of the Carroll Estuary W to NW viewshed.

Figure Scenic-3

Alternatives 2 and 7 Timber Harvest Effects Plot



Carroll Estuary NW by NE Viewshed

Alternative 1 - No Action

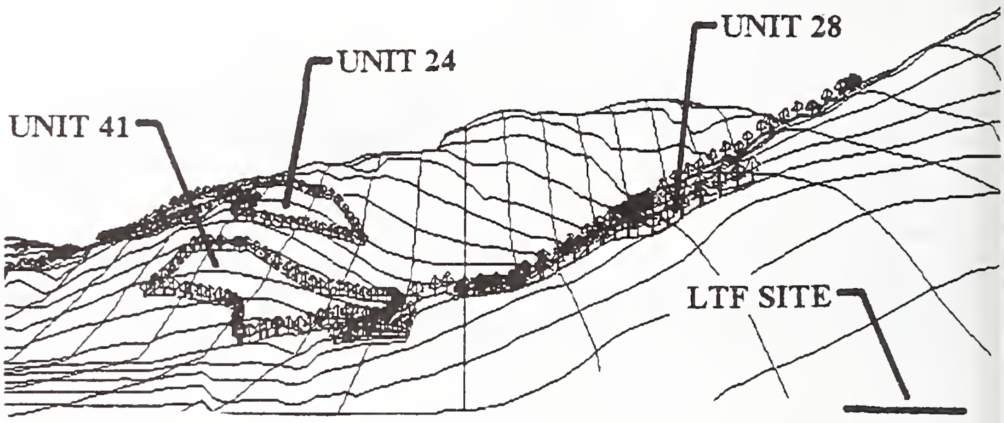
This photopoint views those slopes and shoreline in a northerly direction, from just south of the tidal flats. These heavily vegetated steep hillsides have been altered since the mid-1960s, by timber harvest. The regenerating forest is a mixture of colors and textures with evenly distributed alder and conifers throughout. Edge contrasts are not clearly evident. Currently, this viewshed appears from slightly (Level III) to moderately altered (Level IV) and meets the Partial Retention and Modification VQOs. Left undisturbed, the FVC would remain the same, except for changes in tree height, color, and texture.

The proposed Swan Lake-Lake Tyee Intertie powerline would be visible in this viewshed. Tower structures, right-of-way clearings, and conductor wires would be visible from saltwater viewpoints. It is expected there would be some lessening of potential visual impact if the powerline alignment were to be located in or adjacent to the proposed timber harvest and road corridor openings.

Alternatives 2, 3, 5, 6 and 7

All five action alternatives propose entries in this viewshed ranging from nine to 13 units. Alternative 6 proposes the least amount of visible harvest at 135 acres. Alternative 2 would create the most visual impact from 390 visible acres. This harvest will occur on middleground slopes more than 1 mile away. As designed, all units and roads would meet the Modification VQO, providing no exposed road cuts and rockpits were visible from saltwater. Visible foreground rock pits and road cut-and-fill slopes may not meet the Partial Retention VQO. The FVC would change to moderately and heavily altered in the middleground.

Figure Scenic-4
Alternative 2 Timber Harvest Effects Plot



Carroll Estuary NE by SE Viewshed

This photopoint views those slopes in an easterly to southeasterly direction (towards the Swan Lake power facility). Within this saltwater viewshed, the landscape disturbance can best be described as slightly altered with some evidence of human alteration at and above shoreline. Very steep slopes rise sharply to large, exposed, smooth granite rock faces near the alpine ridgetops. Heavy conifer vegetation is unbroken by landslide chutes, but has several deeply incised "V-notches" or stream courses falling directly to saltwater.

Since the ability of this viewshed to absorb alterations (VAC) is limited, any created, unnatural openings would readily be noticed.

Currently, this viewshed meets the proposed VQOs of Partial Retention in the foreground and Modification in the middleground.

Alternative 1 - No Action

The EVC of this viewshed ranges from an unaltered (Level I) to slightly altered (Level III) landscape. An existing LTF site is visible in the immediate waterline foreground. Left unaltered, the FVC would remain the same, except for natural changes in tree height, color, and texture.

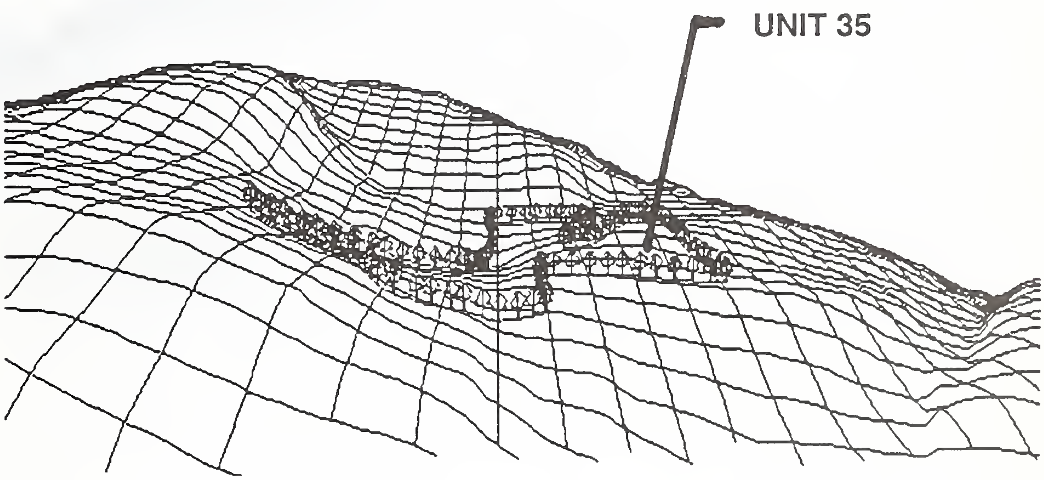
However, were the proposed Swan Lake-Lake Tyee powerline to be constructed, some permanent evidence would be noticeable. Assuming final location of towers and right-of-way clearing would be high above the shoreline just below the rock face, the VQO of Modification would be met. Otherwise, a location lower on the slopes in the immediate foreground would not meet the Partial Retention VQO. A lower alignment location may appear as a drastically altered landscape and would not meet a Partial Retention VQO in the foreground.

Alternatives 2, 3, 5, 6 and 7

All five action alternatives propose entries in this viewshed ranging from four to six units (54 to 119 visible acres). Alternatives 5 and 6 proposes the least amount of visible harvest unit combinations (four at 54 acres). Alternative 7 offers the most visual impact from six combinations of units totalling 96 acres. The additional impacts of exposed rock cut/fill slopes above and below the logging roads and any rock pits may not meet the Partial Retention VQO. Potential mitigations to help meet the VQO include end-haul, utilizing natural benches, and narrow ROW clearing.

With these mitigations in place, all proposed units and roads in all alternatives would meet the proposed VQOs and the FVC would be moderately altered.

Figure Scenic-5
Alternative 7 Timber Harvest Effects Plot



Head of Neets Bay - Easy Point to SSRAA Fish Hatchery

This 3,044-acre saltwater viewshed is located within VCU 737. An anchorage and private fish hatchery are located at the head of this bay resulting in moderate boating activity.

Currently, this viewshed meets the proposed VQO of Partial Retention in the foreground and Modification in the middleground.

Alternative 1 - No Action

The EVC of this viewshed ranges from slightly altered (Level III) to moderately altered (Level IV). Left unchanged, the FVC and its landscape mosaic would remain the same except for continuing changes in tree height, color, and texture.

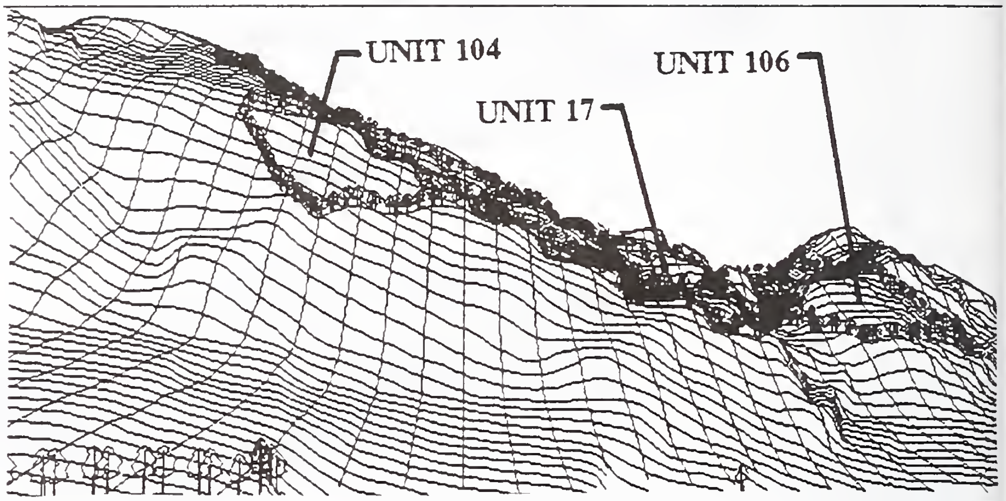
Alternatives 2 and 5

Only Alternatives 2 and 5 propose harvesting timber in this viewshed. Nine units are proposed of which 7 units or 221 acres would be visible on and near the slopes above the SSRAA fish hatchery. As designed, all units and roads would meet the proposed VQOs, providing there would be no exposed road cuts and rockpits visible from saltwater. The FVC would be moderately altered.

Alternatives 3, 6, and 7

There are no proposed harvest units and roads in these alternatives for this viewshed.

Figure Scenic-6
Alternatives 2 and 5 Timber Harvest Effects Plot



Viewsheds Adjacent To Project Area

Saddle Lakes is a potential recreational opportunity immediately adjacent to the Shelter Cove viewshed. The current TLMP classifies this area as LUD III and the proposed TLMP Revision proposes this area be managed as a Scenic Viewshed.

Saddle Lakes Recreation Area Viewshed

This scenic viewshed is currently natural-appearing except for a recreation standard gravel road skirting the north side of the lakes. At some point in the future this road may be joined with a "missing link" road connection from Harriet Hunt Lake to George Inlet and Salt Lagoon. Once this access is connected, Saddle Lakes is planned to be developed as a family campground. A boat ramp at the Shelter Cove LTF would then be constructed affording Ketchikan's residents, and visitors alike, saltwater access to Carroll Inlet and possibly (by boat) to the proposed road network in the Carroll Creek watershed.

Currently, this part of the viewshed meets the proposed VQOs of Retention in the foreground and Partial Retention in the middleground.

Alternative 1 - No Action and Alternative 6

The EVC of this viewshed ranges from natural-appearing (Level II) to slightly altered (Level III) on the lakes' north shoreline. The FVC would remain the same except for continuing change in tree height, color, and texture.

Alternatives 2, 3, 5, and 7

Three harvest units, Units 111, 120, and 121, are proposed on the ridges near the two lakes. Not large in size, ranging from one to nine acres, their location and shape meets the Retention and Partial Retention VQOs.

No perspective plot of this viewshed is provided due to the difficulty of displaying noticeable differences in the forest vegetation from the proposed new harvest areas. Their small size would not appreciably affect or draw the attention of the casual forest visitor.

Cumulative Effects

Alternative 2, which harvests the maximum amount of timber allowed under Forest Plan Standards and Guidelines, was used to project the level of harvest through year 2004. It is assumed that reduced levels of harvest, as part of another alternative, will be harvested in a future entry.

Assuming a continuation of the present harvest level (3-5 entries per 100 years) and implementation of resource constraints, in accordance with the Forest Plan through the year 2140, timber harvest would continue to occur in the Upper Carroll Project Area. Over time, as further entries occur beyond year 2004, the distribution of additional harvest units and/or the proposed Swan Lake-Lake Tyee powerline would add to visual diversity, thereby increasing the capacity of a viewsheds' ability to absorb future alterations. During this time, the forest would become a mosaic of varying sizes, shapes, heights, and textures reflecting those alterations. This mosaic would, therefore, achieve the desired future condition of the Forest Plan.

Land Adjustments, Uses, and Permits

Key Terms

Alaska Native Claims Settlement Act (ANCSA)—provides for the settlement of certain land claims of Alaska natives.
Encumbrance—a claim, lien, charge, or liability attached to and binding real property.
Native Selection—application by Native corporations to the USDI Bureau of Land Management for conveyance of a portion of lands withdrawn under ANCSA in fulfillment of Native entitlements established under ANCSA.
Special Use Permits—permits and granting of easements (excluding road permits and highway easements) authorizing the occupancy and use of land.
State Selection—application by Alaska Department of Natural Resources to the USDI Bureau of Land Management for conveyance of a portion of the 400,000-acre State entitlement from vacant and unappropriated National Forest System lands in Alaska, under the Alaska Statehood Act.

Affected Environment

Land Status

Prior to 1971, the Tongass National Forest, Ketchikan Administrative Area land ownership pattern had not changed significantly, with only minor changes taking place as National Forest System lands were transferred to private home sites, canneries, and townsites. Beginning in the early 1970s, land ownership changes were made as a result of legislation, including the Alaska Native Claims Settlement Act (ANCSA) and the Alaska National Interests Land Conservation Act (ANILCA). Within the Upper Carroll Project Area, there are State land selections, which include parcels totalling 845 acres at Neets Bay (VCU 737). In addition, there are lands being used under special use permits. No timber harvest for the Upper Carroll project is being proposed on any of these encumbered lands.

State Selections
The State of Alaska, under the Statehood Act of 1959, is entitled to select up to 400,000 acres from the National Forests in Alaska. As of July, 1991, 57 percent of the entitlement has been conveyed. Most of the remaining acres have been selected and are in the process of being conveyed by the Bureau of Land Management. Because the State of Alaska was granted the opportunity to select more lands than they were entitled to receive conveyance, some of these lands may become available for National Forest management in the future.

Private Land
There is no other land ownership within the Project Area.

Native Selections
Native selections are authorized under 14(h)(8) of ANCSA. There are no Native selections within the Upper Carroll Project Area.

Special Use Permits

Several special use permits have been issued by the Forest Service for specific exclusive uses in the Neets Creek watershed on National Forest System lands. These lands total 9.5 acres and include those facilities operated by the Southern Southeast Regional Aquaculture Association (SSRAA) in Neets Bay.

Table Land-1 summarizes the special use permit sites at Neets Creek.

Table Land-1
Summary of Special Use Permit Sites

Name of Permittee	Special Use	Legal Description	Management Area	Acres
SSRAA*	dam and water pipeline	T70S, R91E, S22	K32	4
SSRAA*	fish hatchery	T70S, R91E, S29	K32	4.5
SSRAA*	tie down (fish net pens)	T69S, R91E, S33	K32	1

*SSRAA- Southern Southeast Regional Aquaculture Association

The Alaska Energy Authority is authorized a special use permit for the power transmission line which passes through the North Saddle Lakes area and crosses Carroll Inlet to the Swan Lake generating site.

Mining Claims

There are no known mining claims for locatable minerals within the Upper Carroll Project Area.

Effects of the Alternatives

Alternative 2 will reconstruct a road through the SSRAA special use permit site at Neets Bay. This road reconstruction will require modification of the existing water pipeline. Alternatives 3, 5, 6 and 7 will not directly affect the status of existing special use permits or mining claims. Alternatives 2, 3, 5, 6 and 7 may require the issuance of new special use permits for camp developments.

Permits and Easements

No alternatives propose locating timber harvest units or constructing roads near the Misty Fiords National Monument boundary, which would have required updated land line surveys. Future conveyance of the State Land Selections at Neets Bay will require the Forest Service to reserve a transportation right-of-way along the existing and proposed road alignments on the selected lands.

Roads and Facilities

Key Terms

Access management—acquiring rights and developing and maintaining facilities needed by people to get to and move through public lands.
Arterial roads—roads usually developed and operated for long-term land and resource management purposes and constant service.
Collector roads—collect traffic from Forest Local roads; usually connect to a Forest Arterial road or public highway.
Local roads—provide access for a specific resource use activity such as a timber sale or recreational site; other minor uses may be served.
Log transfer facility (LTF)—a facility that is used for transferring commercially harvested logs to and from a vessel or log raft, or the formation of a log raft.
Main trunk roads—primary roads that are used repeatedly for forest access over long periods of time.
Modular bridge—a portable bridge constructed of components that can be readily assembled and disassembled for movement from one site to another.
Pre-haul maintenance—work performed prior to use of a road for timber harvest activities; includes blading, shaping, and brush removal.
RP—Riparian areas
Temporary roads—short-term roads built for limited resource activity or other project needs.
Traffic service levels—traffic characteristics and operating conditions that are used in setting road maintenance levels.

Affected Environment

The transportation system on Revillagigedo (Revilla) Island consists of many small isolated road systems scattered around the island and located close to the shoreline. These road systems are under the jurisdiction of either the federal, state, or local governments, or private interests. All roads in the Project Area are under the jurisdiction of the Forest Service. Timber harvest and related Forest Service management activities are the primary purposes for transportation development. These roads are isolated and do not connect with the greater Ketchikan road system.

The Upper Carroll Project Area contains no public transportation facilities (state highways, ferry dock, or airports). Currently, the Project Area has approximately 10.1 miles of open road. There are additional existing roads that were constructed prior to 1970, using low-design standards that are currently overgrown and are not usable. Any use of these roads will be considered reconstruction.

Forest Transportation System

The Forest Transportation System includes three types of roads: arterials, collectors, and locals. Arterial and collector roads are usually maintained for use by passenger vehicles and are usually designed with more emphasis on mobility than local roads. Most local roads are not designed or maintained to accommodate passenger vehicles. Construction of roads for timber harvest activity varies from year to year on Revilla Island. From 1990 to present, approximately 81 miles of local roads have been constructed on Revilla Island. These roads were constructed under the Shelter Cove FEIS Record of Decision (ROD) and the North Revilla FEIS ROD.

The transportation system on Revilla Island can be broken into four categories: (1) State and Municipal roads (all state and municipal roads are outside the Project Area); (2) private roads (no private roads existing within the Project Area); (3) Forest Service Roads; and (4) log transfer facilities (LTFs).

There are approximately 321 miles of Forest Service roads on Revilla Island; 14.2 miles are within the Project Area. Since most of the roads do not connect to other existing road systems on Revilla Island, they are not maintained for passenger vehicles unless timber harvest operations are active. These single-lane, rough-rock roads are primarily designed for use by heavy, off-highway logging trucks to implement silvicultural activities on the National Forest .

Traffic service levels portray the expected traffic characteristics for forest roads in the Project Area (see Appendix E, Transportation).

Table Roads-1 displays the amount of miles of road by traffic service level and by alternative.

Table Roads-1
Miles of Road By Traffic Service Level

	Traffic Service Level C		Traffic Service Level D	
Alt.	Existing	Planned	Existing	Planned
1	1.0	0	13.2	0
2	1.0	31.1	13.2	36.7
3	1.0	6.7	13.2	18.6
5	1.0	16.5	13.2	31.3
6	1.0	8.7	13.2	14.2
7	1.0	2.8	13.2	1.3

SOURCE: Oien 1996

Maintenance Levels
Maintenance levels are based on the anticipated use of the roads. Because roads in the Project Area are isolated, predominantly intermittent resource management, off-road vehicular and foot traffic is expected.

Applicable maintenance levels for the Project Area are as follows:

- Maintenance Level 1 (Traffic Service Level D)–Roads are closed by bridge removal, organic encroachment, or other closure methods and are monitored for resource protection.

- Maintenance Level 2 (Traffic Service Level C)–Roads are maintained for high clearance vehicles and monitored for resource protection.

During resource management activities, the roads will be maintained commensurate with that activity. After completion of the management activity, these roads will revert back to the above maintenance levels.

Road Development
Road development patterns are similar from one alternative to another due to the location of the resource being used, terrain characteristics, and development costs. Roads are located to minimize disturbance on the land, yet provide access to resources. Thus, road locations generally follow routes of favorable terrain where practicable.

Construction and Reconstruction of Roads
Three classes of road would be constructed as part of the proposed project, each class having different projected uses and construction standards. Temporary roads were considered local roads for analysis purposes, since these roads are similar to local roads.

Arterial and collector roads are generally mainline roads requiring higher standards and heavier investment to provide prolonged use. These roads can be built to lower standards initially and upgraded as use intensifies. Thus, the logging operator may construct arterial and collector roads to low or medium standards depending on use.

Forest roads are designed to varying standards depending on use.

Local roads are generally single purpose roads resulting in lower design standards and usually cost less than arterial and collector roads.

Road reconstruction consists of complete roadbed repairs, major culvert or bridge replacement, roadbed realignment, and/or resurfacing. All haul maintenance consists of ditch cleaning, road side brush removal, roadbed surface blading, and installation of minor pipes.

Construction and Reconstruction of Major Drainage Structures

Since the 1960s, timber harvest activities have occurred in the Project Area. Until 1980, many of the drainage structures of the Forest transportation system were constructed from native materials which had a safe working life of eight to 12 years. Consequently, existing roads will require reconstruction and drainage structure replacement. On both new and existing roads, modular bridges and permanent culverts will be used.

In situations where temporary roads cross Class III streams, temporary log stringer bridges may be used and removed upon completion of use. Temporary log stringer bridges may also be used on specified roads during road construction, prior to installation of the permanent structure, to facilitate timing and scheduling concerns.

Rock Quarry Disposition Locations

Generally, rock borrow quarries are located every one to two miles along roads. The quarry location is determined by quality rock sources, haul distances, development costs, frequency of entry, and visual resource considerations. An allowance for rock quarries is included in the acres shown for ROW clearing.

Some rock quarries are small, one-time uses, while others are expanded during future road building operations if quality rock is available.

Rock quarries with expansion potential will be retained for expansion, particularly in situations where potential roads and timber harvest may be developed in the future, or where numerous roads radiate out from a point near a centralized quarry. Rock quarries near the ends of the road system will be closed and reclaimed by spreading stockpiled overburden on the floor of the quarry.

Each quarry will be evaluated for disposition during the construction stage. Each quarry will be evaluated for the following: (1) availability of additional quality rock; (2) feasibility of expansion; and (3) future rock resource needs in the area.

Log Transfer Facilities (LTFs)

The transportation of harvested timber on Revilla Island requires that the log bundles be removed from the log trucks, placed in the water, and rafted to the sort yard at Thorne Bay and to the Ward Cove mill. Due to the isolated nature of the Project Area, this transportation will require the use of log transfer facilities (LTFs). LTF consolidation, by connecting to existing sites, is to be considered where feasible to minimize impacts to beach and marine zones. Consolidation would avoid the need to build LTFs on encumbered or state selected lands. Further analysis of LTFs is discussed in the Marine Environment and Log Transfer Facilities section of this chapter.

Effects of the Alternatives

The effects of the transportation system on other resources are considered in the sections relating to those resources (soil, water, visuals, fisheries, marine environment, etc.). This section focuses on the effects of each alternative on the transportation system, and will be grouped into the following categories: (1) Construction Costs; (2) Road Development; and (3) Access Management.

Table Roads-2 displays the transportation development costs by alternative.

Table Roads-2
Transportation Development Costs (in MM$) by Alternative

	Alternative 1	2	3	5	6	7
New Construction Miles	0.00	61.19	21.09	39.84	19.29	0
New Construction $	0.00	19.88	6.50	12.20	5.95	0
Reconstruction Miles	0.00	6.56	3.67	7.90	3.67	3.67
Total Reconstruction $	0.00	1.30	0.54	0.99	0.54	0.54
Bridge Const./Reconstruction $	0.00	2.40	0.50	1.28	0.79	0.50
LTF Construction/Reconstruction						
Carroll Inlet* $	0.00	0.00	0.08	0.08	0.08	0.08
Existing LTF						
Shrimp $	0.00	0.00	0.00	0.00	0.00	0.00
Shelter $	0.00	0.00	0.00	0.00	0.00	0.00
Total LTF Reconstruction $	0.00	0.00	0.00	0.00	0.00	0.00
Total Construction and Reconstruction Cost $	**0.00**	**23.58**	**7.62**	**14.58**	**7.36**	**1.04**

SOURCE: Oien 1996

*Carroll Inlet reactivation site to be reconstructed or a new LTF will be constructed.

Road Development

The position and spatial arrangement of resource areas and the amount of harvesting that would occur in new undeveloped areas requires changes in the road system. Proposed new roads are needed to harvest the timber volume associated with each alternative. A total of 174 miles of road would eventually be needed to harvest all suitable and available timber in the Project Area. The total planned roads are the roads needed to harvest the remaining timber volume in the rotation associated with each alternative. Road development includes expansion of the current road system in all action alternatives.

Table Roads-3
Total Transportation Systems (Miles)

Alternative	Total Existing Roads	Existing Roads Used	Proposed New Roads	Total Transportation System
2	14.15	12.60	61.19	73.79
3	14.15	8.3	21.09	29.39
5	14.15	9.2	39.84	49.04
6	14.15	4.5	19.29	23.79
7	14.15	6.5	0.00	6.5

SOURCE: Oien 1996

Discrepancies may be found between tables due to rounding

Expansion of the road system requires: (1) Construction of varying classes of roads, (arterial, collector, and local); (2) reconstruction of some existing roads; (3) construction and reconstruction of varying types of major drainage structures; (4) construction coordination activities with other resource needs; and (5) proposed federal activities on State of Alaska Land Selections.

Construction and Reconstruction of Roads

The development of arterial, collector, and local roads occurs in all action alternatives. Alternatives 2 and 5 develop the most miles (61.19 and 39.84 respectively) and highest costs, while Alternative 7 develops the least miles (0.00) and the lowest costs. The level of local road development is not directly proportional to the level of harvest in each alternative, because of differing spatial arrangements of harvest units between alternatives.

The miles of roads to be developed are shown by road class in Tables Roads-4 and Roads-5. Table Roads-2 displays the miles of new road and major drainage structure costs.

Table Roads-4
Existing Roads Proposed for Use for this Project

	Alternative					
Road Class	**1**	**2**	**3**	**5**	**6**	**7**
Arterial Miles	0	4.11	1.05	1.05	0.74	2.10
Collector Miles	0	3.85	2.93	2.93	2.93	2.93
Local Miles	0	6.19	4.32	6.27	0.83	1.50
Total	**0**	**14.15**	**8.30**	**8.30**	**4.50**	**6.53**

SOURCE: Oien 1996

Table Roads-5
Proposed New Roads for this Project

	Alternative					
Road Class	**1**	**2**	**3**	**5**	**6**	**7**
Arterial Miles	0	27.16	3.77	11.23	6.35	0
Collector Miles	0	0	0	0	0	0
Local Miles	0	34.04	17.31	28.61	12.94	0
Total	**0**	**61.20**	**21.08**	**39.84**	**19.29**	**0**

SOURCE: Oien 1996

Reconstruction

Reconditioning of existing roads is associated with all action alternatives. Activities range from major realignment and bridge replacement to minor blading and shaping of the existing road from proposed harvest units to the existing and new LTFs.

Table Roads-6 displays the miles and cost of heavy reconstruction for all alternatives. Pre-haul maintenance is not displayed as it is assumed all roads require some minor surface blading and ditch cleaning and brushing prior to commencement of log hauling operations.

Table Roads-6
Road Reconstruction

Alternative	Miles	Cost (Million $)
1	0.00	0.0
2	6.56	1.3
3	3.67	1.0
5	7.90	1.7
6	3.67	1.0
7	3.67	1.0

SOURCE: Oien 1996

Road Connections to Eliminate LTF sites

If road connections between LTF tributary areas are feasible and practical, LTF sites can be eliminated. It is feasible to connect the proposed Carroll LTF to the existing LTF at Shelter Cove.

Connection of the Carroll LTF to Shelter Cove LTF would require construction of a seven-mile section of road along the existing powerline corridor to Swan Lake and may be the future transportation link with Ketchikan. This link would eliminate the need for a LTF in Upper Carroll Inlet. Construction of this road would not access additional timber for the project. Construction would be across large areas of steep ground and would cross numerous difficult V-notch crossings. This connection was considered in Alternative 2, which reflects the high cost of the road connection.

Connection of the Fire Cove LTF to the Neets Bay road system would not eliminate the need for an LTF, but would connect the Fire Cove system to the Shrimp Bay System, to Carroll Inlet system, and ultimately to the Ketchikan transportation system. The connection would give the option of hauling the Neets Bay drainage system timber to the Fire Cove LTF in lieu of the Shrimp Bay LTF.

Construction Coordination with Fish and Wildlife

Construction Near Eagle Nest Trees

Road construction is not anticipated to be within 330 feet of any inventoried eagle nest trees in the Project Area.

In accordance with an agreement between the U.S. Forest Service and the U.S. Fish and Wildlife Service, specific criteria concerning road construction within one-half mile of an active eagle's nest is implemented to mitigate disturbance to eagles. There are no new roads planned, planned reconstruction, or existing roads within the one-half mile zone of any known eagle nests on the Project Area.

Construction Near Goat Winter Range

To avoid disturbing parturient nannies and new-born kids, blasting within one mile of birthing areas will be postponed during the period of May 15 to June 15, if mountain goats are found to be present.

Construction Near Streams

Road construction requires numerous stream crossings. Many of the streams are habitat for various fish species. It is necessary to minimize impacts on these streams to protect salmon fry and eggs. Maintaining fish passage characteristics and scheduling construction activities (fish timing) around fish movements are methods used in mitigating impacts of roads on streams.

Some stream crossings have been identified as needing fish timing restrictions, for construction of structures, to minimize impacts on fish eggs and fry. Generally, these restrictions can be accommodated through planning and scheduling of the construction activities. In many cases, additional costs would be incurred to accommodate the timing restrictions. Such costs would include additional equipment mobilization and demobilization, increased construction actions for mitigation, and increased construction delays. The number of crossings, the acres of buffers affected by road crossings, and the number of crossings with fish timing and/or passage restrictions are displayed in Table Roads-7 and Roads-8. It is estimated that approximately 250 feet of road is involved in crossing a Class I and II stream and buffer; 200 feet for the buffer crossing and 50 feet for the stream channel crossing. Class III crossing miles and acres are not shown.

Table Roads-7
Number of Proposed Riparian Area Stream Crossings

RP Crossing	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Class I	0	15	11	17	10	8
Class II	0	25	11	17	13	1
Class III	0	127	72	74	52	3
Total Crossings	**0**	**167**	**94**	**408**	**75**	**12**

SOURCE: Oien 1996

Table Roads-8
Riparian Area Stream Crossings by Number of Crossings and Miles and Acres Affected*

Alternative	No. of Crossings	Miles	Acres
2	40	1.89	13.6
3	22	1.10	7.48
5	34	1.70	11.56
6	23	1.15	7.82
7	9	0.40	3.06

SOURCE: Oien 1996

* Road clearing width is estimated to be an average of 75' wide including rock pits.

The estimated number of stream crossings requiring fish timing and/or passage for the Project Area are displayed in Table Roads-9.

Table Roads-9
Number of Crossings with Fish Timing and/or Passage Restrictions

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Timing and Passage	0	30	22	34	23	9
Passage	0	3	1	1	3	0
Timing	0	33	23	53	27	3

SOURCE: Oien 1996

* These costs are included in the total road construction and reconstruction costs in Table Roads-2.

Road Construction Within TTRA and RP Prescription Zones

Roads will be located within stream zones where it is the environmentally preferred choice and where it is consistent with safety regulations. When these roads are designated on the ground, care will be taken to keep as much of the road as possible outside TTRA and RP Prescription Zones. In most cases, the limiting factor will be the type of terrain adjacent to the various stream zones, which will govern how much of a given road segment can be located outside these zones.

Some road development inside the TTRA and RP Prescription Zones is unavoidable. For example, roads accessing LTFs will require location in beach and, in some cases, estuarine zones.

Tables Roads-11 and Roads-12 display the planned and existing miles and acres of roads in the TTRA and RP Prescription Zones. The existing mileage shown in Roads-11 and Roads-12 includes only the existing miles of road used in the alternatives. There are additional existing roads in the Project Area that are not proposed in the alternatives. For a discussion of stream buffers, see Chapter 3, Water Resources (Tables Water-1 through Water-3).

Table Roads-10
Road Development in Stream Zones

Alternative	Existing Roads Used Miles	Existing Roads Used Acres	Planned Miles	Planned Acres
1	0.0	0	0.0	0
2	0.85	7.38	1.25	10.25
3	0.60	4.92	0.55	4.51
5	0.60	4.92	0.25	2.05
6	0.45	3.69	0.70	5.74
7	0.60	4.92	0	0

SOURCE: Oien 1996

Table Roads-11 displays the existing and proposed road development affecting the TTRA lake zones.

Table Roads-11
TTRA Lake Zones Affected by Roads

Alternative	Existing Roads Used Miles	Existing Roads Used Acres	Planned Miles	Planned Acres
1	0	0	0	0
2	0.75	6.82	0.50	4.55
3	0	0	0	0
5	0.75	6.82	0	0
6	0	0	0	0
7	0	0	0	0

SOURCE: Oien 1996

Table Roads-12 shows the existing and proposed road development affecting the RP Lake Prescription zone.

Table Roads-12
RP Lake Prescription Zones Affected by Roads

Alternative	Existing Roads Used Miles	Existing Roads Used Acres	Planned Miles	Planned Acres
1	0	0	0	0
2	0.2	1.82	0.25	2.27
3	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0

SOURCE: Oien 1996

Note: Includes both no-cut and partial cut zones

Table Roads-13 displays the existing and planned roads affecting the Estuarine Zones development (1000 feet).

Table Roads-13
Estuarine Zones Affected by Roads

Alternative	Existing Roads Used Miles	Existing Roads Used Acres	Planned Miles	Planned Acres
1	0.0	0	0.0	0
2	0.6	5.7	4.25	40.29
3	2.1	19.9	0.75	6.82
5	2.1	19.9	0.75	6.82
6	2.1	19.9	0.75	6.82
7	2.1	19.9	0	0

SOURCE: Oien 1996

Table Roads-14 portrays the existing and planned road development affecting the beach zones (500 feet).

Table Roads-14
Beach Zones Affected by Roads

Alternative	Existing Roads Used Miles	Existing Roads Used Acres	Planned Miles	Planned Acres
1	0	0	0	0
2	0.75	6.82	5.0	45.5
3	1.25	11.36	0	0
5	1.25	11.36	0	0
6	1.25	11.36	0	0
7	1.25	11.36	0	0

SOURCE: Oien 1996

Table Roads-15 shows the existing and planned road development affecting the RP stream prescription (no-cut) zones (100 feet).

Table Roads-15
RP Stream Prescription (No Cut) Zones Affected by Roads

Alternative	Existing Roads Used Miles	Existing Roads Used Acres	Planned Miles	Planned Acres
1	0	0	0	0
2	0.90	7.38	1.75	14.35
3	0.60	4.92	0.60	4.92
5	0.60	4.92	1.85	15.17
6	0.60	4.92	0.90	7.38
7	0.60	4.92	0	0

SOURCE: Oien 1996

Table Roads-16 portrays the existing and planned road development affecting the RP stream prescription (Partial-Cut) Zones.

Table Roads-16
RP Stream Prescription (Partial Cut) Buffer Zones Affected by Roads

	Existing Roads Used		Planned	
Alternative	Miles	Acres	Miles	Acres
1	0.0	0	0.0	0
2	0.35	2.87	2.37	17.23
3	0.20	1.64	1.03	7.49
5	0.20	1.64	1.43	10.40
6	0.20	1.64	1.09	7.92
7	0.20	1.64	0.99	7.20

SOURCE: Oien 1996

Road Construction Within Wetlands

Peatlands, which includes bogs and fens, are treated differently than other wetlands due to their great expanse on the landscape in Alaska. Experience has shown that, with an overlay construction technique, roads can be built across peatlands when appropriate fill material such as rock, logs, wood chunks, wood chips, or geotextiles are used to construct a stable road base. As wetlands generally occur on flatter slopes, the width of the affected area is less than the average right-of-way width used for calculation of acres in for other resources such as TTRA buffers. The 75-foot calculated average right-of-way width includes acreage for rock quarry sources, which are not usually in wetlands areas. The right-of-way width also is the average for all sideslopes from flat ground to full bench (55 percent plus). With wetlands being on the flatter slopes where there is overlay construction, clearing widths will vary from 20-30 feet wide depending on slope, horizontal and vertical alinement of the road, and other safety related requirements. Where practicable, standard road construction across peatlands excludes road-side ditches that would disrupt subsurface drainage patterns and create altered wetness conditions. Providing adequate cross drainage is an important consideration for maintaining natural runoff patterns. Wetlands will not be used for disposal of endhaul material. For further information on wetlands, see Riparian Areas, Floodplains and Wetlands, Chapter 3.

Proposed Activities on State Land Selections

No road or LTF development will take place within State lands. Alternative 2 proposes 1.8 miles of new construction and 2.4 miles of reconstruction on State select lands. The road corridor proposed from Neets Bay to Fire Cove and Neets Bay to Shrimp Bay will be reserved from the selections.

Utility Corridor

The Tongass Land Management Plan Revision team has mapped the transportation and utility corridors on the Tongass National Forest. The maps show two corridors passing through the Project Area. The Alaska Legislature passed Senate Joint Resolution 40 during the 1992 session. This resolution urges the Forest Service to avoid actions which would preclude the use of any of the transportation and utility corridors identified by an interagency group.

The Upper Carroll Project Area contains approximately 30 to 40 miles of the various potential routes identified to date. The IDT reviewed the possibilities of action being taken on the transportation and utility corridors in the foreseeable future. The review indicated that the corridor could be used for electrical transmission lines within the next decade. The review concluded that the road connections proposed are unlikely within the forseeable future and that no actions proposed under any alternative would preclude use of any of the transportation and utility corridors.

The *Lake Tyee to Swan Lake Transmission Intertie* (R.W. Beck and Assoc., 1992) presents a feasible electric power transmission line route within the Project Area. The preferred route identified in the R.W. Beck study passes through the Project Area by way of Carroll Creek and Neets Creek drainages (Figure Roads-1).

The Ketchikan Gateway Borough and the Alaska Department of Transportation and Public Facilities cooperated in an examination of highway corridor opportunities. This study, *Ketchikan - Revillagigedo Island Corridor Study* (R&M Engineering, 1992), identified a preferred highway route that passes through the Project Area along the west side of Carroll Inlet, then north along Carroll Creek until the junction with Neets Creek and Orchard Creek. At this point, one potential route heads north outside the Project Area toward Orchard Lake, the other route follows Neets Creek before heading north to Shrimp Bay. As part of the Upper Carroll field reconnaissance, the Forest Service located and flagged on the ground the preliminary route from Shelter Cove to Shrimp Bay. This alternative route uses a ferry terminal at Shrimp Bay as an alternative to the route on the north side of Orchard Lake and some very difficult highway building terrain north of Shrimp Bay.

The IDT considered these routes in alternative formulation and also evaluated them for likelihood of construction within the foreseeable future through other means. For the purpose of this analysis, the reasonably foreseeable time frame over which the indirect effects are estimated is until the end of the Ketchikan Pulp Company (KPC) Long-term Contract (the year 2004). This determination of reasonably foreseeable is based on the time frame of the KPC contract commitment.

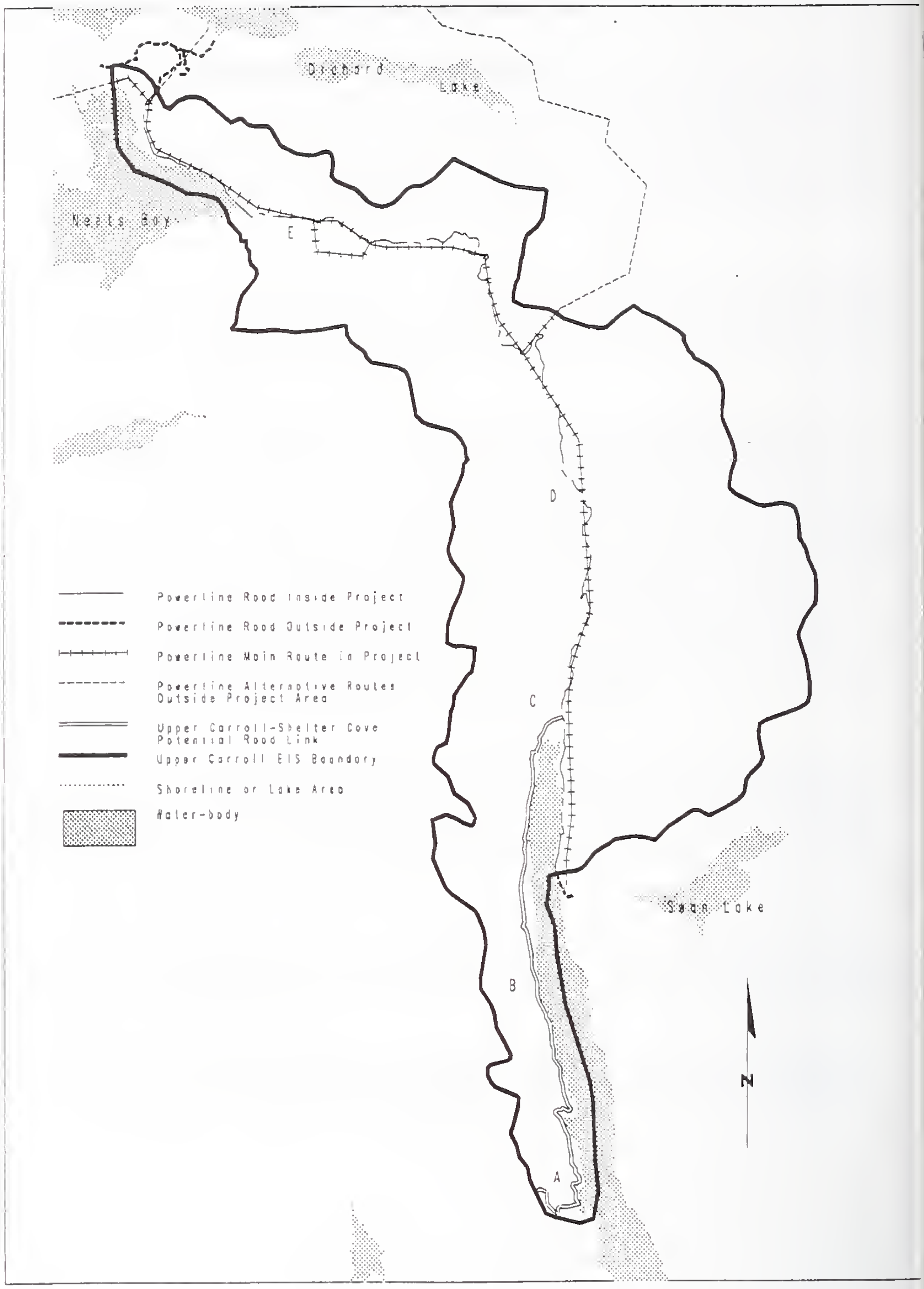
Based on the feasibility and likelihood of funding for power transmission projects within Alaska, the IDT concluded that the construction of the Swan Lake-Lake Tyee powerline was likely within the foreseeable future.

The effects of the possible construction of the power line within the Project Area have primary effects on the visual resource. The clearing of the corridor along the transmission lines would be seen from a number of view points.

The actions proposed in the Project Area could benefit the transmission project by incidental transportation and logistics uses. The construction of the transmission lines across National Forest lands normally requires removal of all merchantable timber felled along the corridor. The road system will allow shorter flights for helicopters removing the timber which would reduce costs. The roads will also allow shorter transportation by helicopter for towers, cable, and other logistics. This activity is expected to result in a reduction of costs.

Figure Roads-1 illustrates the proposed utility corridor.

Figure Roads-1
Proposed Utility Corridor



Other Facilities within the Project Area

Under Alternative 2, log raft, equipment transport, and camp mobilization will require towing operations through the Southeast Alaska Acoustic Measurement Facility area. Towing operations will require coordination with operation of the acoustic facility. Approximately seven to eight tow trips are expected for transporting timber resources from the Project Area to processing centers. Some tow delays may be expected.

Access Management

In all the proposed action alternatives, access to the road system is by boat or float plane. Due to these limits, vehicular use is expected to be negligible except for some use of off-highway vehicles while roads are open. The mainline road will access the proposed Swan Lake-Lake Tyee intertie powerline but will be closed to all use upon completion of silvicultural activities. Consequently, access management will consist of managing roads for silvicultural activities, (Road Maintenance Levels 1 and 2) including salvage harvest and other post sale silvicultural activities.

Roads are closed for numerous reasons including fish and wildlife protection, public safety, other resource protection, and inadequate maintenance funding. It may be necessary to close roads or portions of roads to use by specific vehicle types. Roads under Forest Service jurisdiction can be closed by authority of CFR 36, Ch.11, parts 212.7 and 261. Road closure orders will be posted at the Ketchikan Ranger District office.

Road Disposition

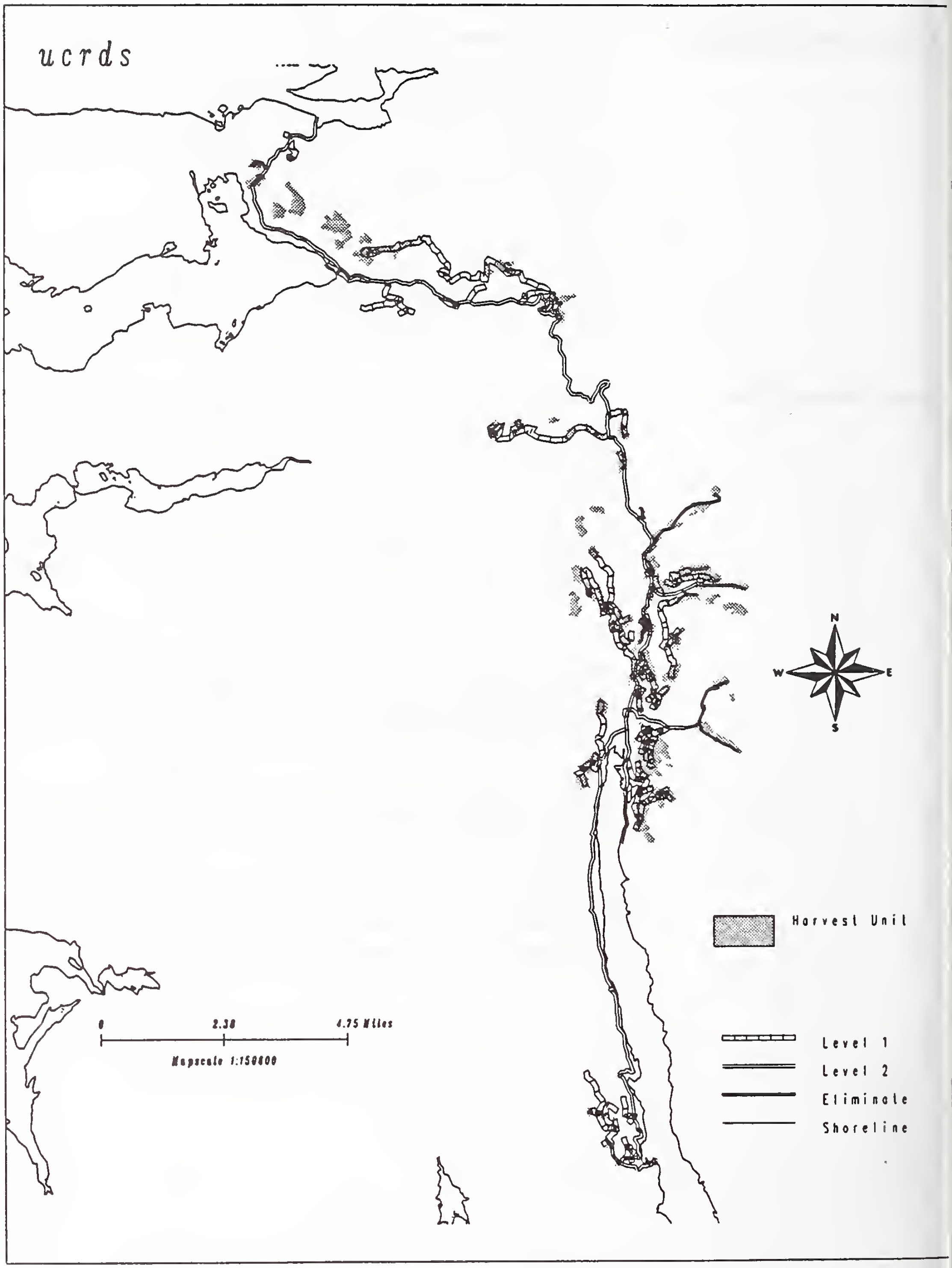
Maintenance of the roads will consist of monitoring road and drainage structures for functional and environmental condition. Permanent drainage structures will be installed to meet long-term access objectives; however, maintenance levels fluctuate in response to changing uses. During periods of limited use, maintenance standards are sufficient to provide only for administrative use and resource protection. Post sale road management objectives are to keep the road open for administrative activities and to facilitate maintenance for resource protection. Maintenance Level 1 will be applied to these roads, which will include drivable waterbars to safeguard minor drainage structures. This measure will minimize erosion in the event of structure failure.

Bridges will be removed and used in other locations. The roads behind bridges will not be maintained for vehicular traffic; however, drainage structures will be monitored for functional condition. Maintenance Level 1 will be applied to these roads, which will include drivable waterbars to safeguard minor drainage structures. This measure will minimize erosion in the event of structure failure.

Temporary roads are not being retained on the permanent transportation system. These roads will be closed by removing structures, construction of water bars and revegetated in accordance with NFMA.

Figure Roads-2 illustrates the roads in the Project Area to remain open with limited maintenance and the roads to be closed. The Summary of Road Management Objectives, containing the specific disposition of all existing and proposed roads, is in Appendix K.

Figure Roads-2
Roads Open and Scheduled for Closure



Marine Environment, Log Transfer Sites, and Related Facilities

Key Terms

A-frame LTF—log transfer facility system which consists of a stationary mast with a falling boom for lifting logs from trucks to water. This system is generally located on a shot rock embankment with a vertical bulkhead to access deep water, accommodating operations at all tidal periods.
Low-angle ramp LTF—log transfer facility system which consists of a drive-down slide ramp with slide rails for pushing log bundles into the water.
Log transfer facility (LTF)—a facility that is used for transferring commercially harvested logs to and from a vessel or log raft, or the formation of a log raft.
Marine benthic habitat—the area occupied by the aggregate of organisms living at or on the bottom of a water body.

Affected Environment

Marine Environment

Southeast Alaska's coastline consists of approximately 30,000 miles of tidal shoreline, roughly 60 percent of the total Alaskan coast. Within this region occurs a great diversity of habitats that collectively account for the complexity of Southeast Alaska's estuary and tidal environments.

The marine environment encompasses a wide variety of ecosystems. The intertidal and subtidal marine environments are subject to effects from log transfer and storage facilities; those are the points of concentrated activity associated with the marine transportation of logs. The preferred sites for log transfer facilities (LTFs), log storage areas, camp settlements, and anchorages are deep bays or along straits or channels. These areas are preferred because the deeper water and stronger currents flush out bark and debris that may enter the water, resulting in less effects on marine life. Other marine areas are not addressed here because they are not expected to be affected by activities associated with the timber harvest of this project. Activities outside the areas of concentration are widely dispersed. Any potential effects would be short term and/or diluted below detectable thresholds.

The shallow marine waters and associated mud flats and estuaries found in the protected coves and bays provide habitat for some important species such as Dungeness crab and juvenile salmon. They are part of a complex and dynamic ecosystem that includes shrimp, flatfish, marine worms, echinoderms, sponges, sea anemones, shellfish, plankton, marine algae, and other organisms.

Log Transfer Facilities (LTFs)

The transportation of harvested timber on the Project Area requires that the logs must be trucked or flown to the ocean, transferred to the water or barges at a LTF and towed to Thorne Bay for sorting. They are then moved to processing sites like the pulp mill at Ward Cove or the sawmill at Metlakatla.

There are three existing LTFs within the Project Area that were constructed from the 1970s through the 1990s. LTFs from the 1970s were modified to meet the current State and Federal permit requirements as part of the North Revilla FEIS. All LTFs are owned by the Forest Service.

Table Marine-1 displays the existing LTF locations and the decade of construction.

Table Marine-1
Existing LTFs Associated with the Project Area*

Facility Location	LTF No.	Active Facility	Decade of Construction 1970s	1980s	1990s
Shrimp Bay	1	Yes	x		
Fire Cove	2	Yes	x		
Shelter Cove	3	Yes			x

SOURCE: Oien 1996

* These sites were reconstructed or will be reconstructed under the Shelter Cove and North Revilla EISs. These sites meet all applicable EPA requirements.

Figure Marine-1 and Table Marine-2 display the locations of existing and proposed LTFs in the Project Area.

Figure Marine-1
Existing and Proposed LTFs for Each Alternative

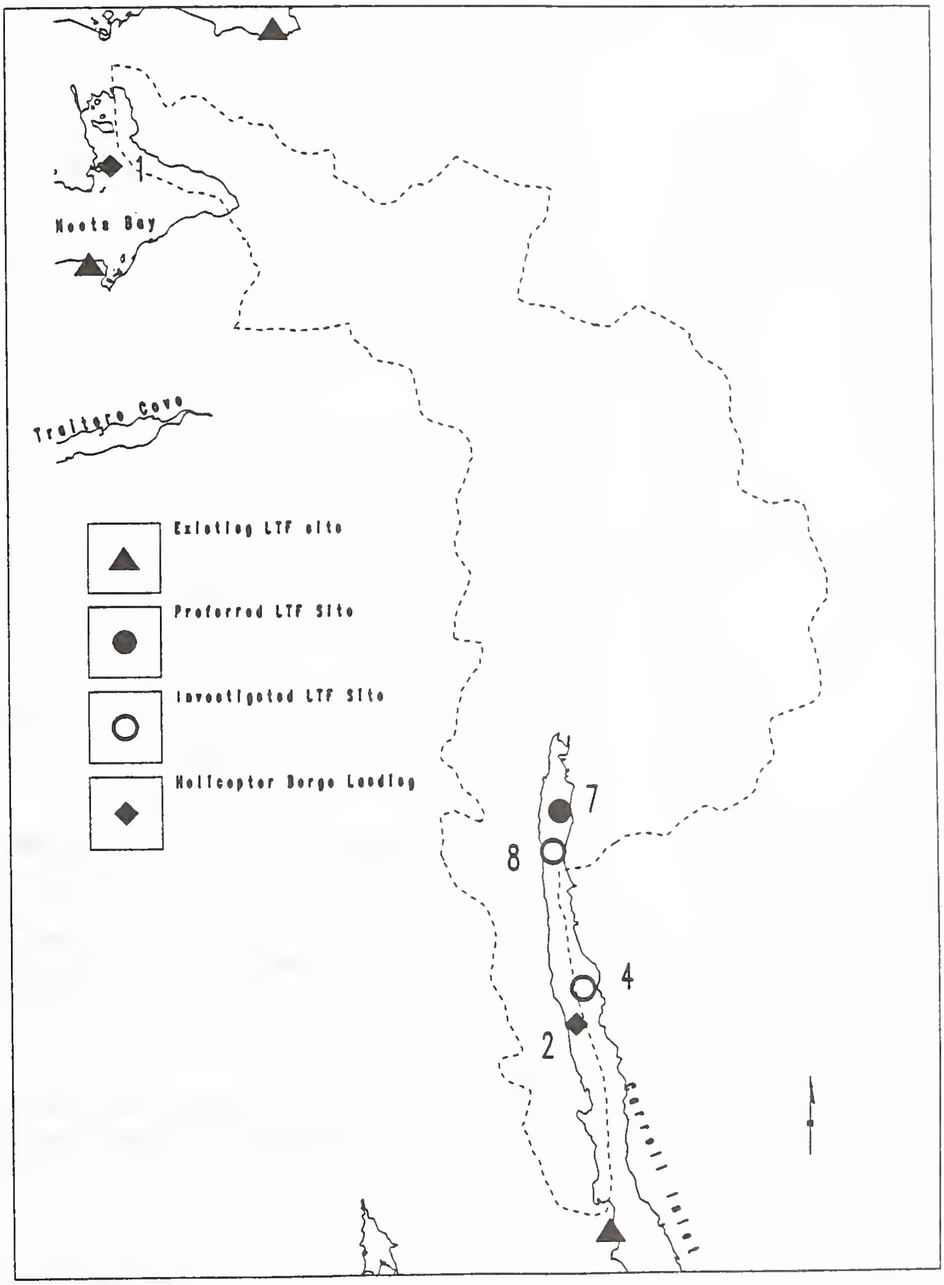


Table Marine-2
LTF Locations

Location	Site No.	Latitude	Longitude
Shrimp Bay	1	55° 49' 57"N	131° 29' 57"W
Fire Cove	2	55° 46' 29"N	131° 33' 19"W
Shelter Cove	3	55° 33' 25"N	131° 21' 00"W
Carroll Inlet (No. 7)	4	55° 37' 00"N	131° 21' 00"W

SOURCE: Oien 1996

Log Transfer Methods

Four log transfer methods are considered in this analysis. These are: (1) low-angle ramp with rafting facilities; (2) A-Frame type entry device with rafting facilities; (3) a dry land to barge transfer facility; and (4) helicopter placement of logs directly into the ocean or onto a barge.

A-frame

The A-frame method generally consists of a stationary mast with a falling boom for lifting logs from trucks to water. This system is generally located on a shot rock embankment with a vertical bulkhead to access deep water, accommodating operations at all tidal periods.

A modified version of this method uses a stationary A-frame boom with sloping guide rails placed on the bulkhead to guide the logs to deep water at lower tidal levels. Both A-frame systems allow controlled entry of logs into the water.

Low-angle Ramp

The low-angle ramp method consists of a shot-rock ramp sloped at 10 to 15 percent grade with wood or steel rails on the ramp surface. Log bundles are walked down the ramp into the water by use of a rubber-tired log loader.

Land-to-Barge

The land-to-barge transfer system requires a deep water bulkhead for the barge mooring facility. A minimum of 25 feet of water at low tide is required for barge operations. Logs are loaded directly onto the barge by use of a loader. Barges can also be loaded with logs floating in the water by use of onboard cranes. Land-to-barge operations were not utilized in the final analysis because of high operating costs and impacts of rebuilding the existing LTFs to accept barges. Most of the sites in the Project Area will be handling small volumes of timber and use of barges is economically prohibitive.

Helicopter

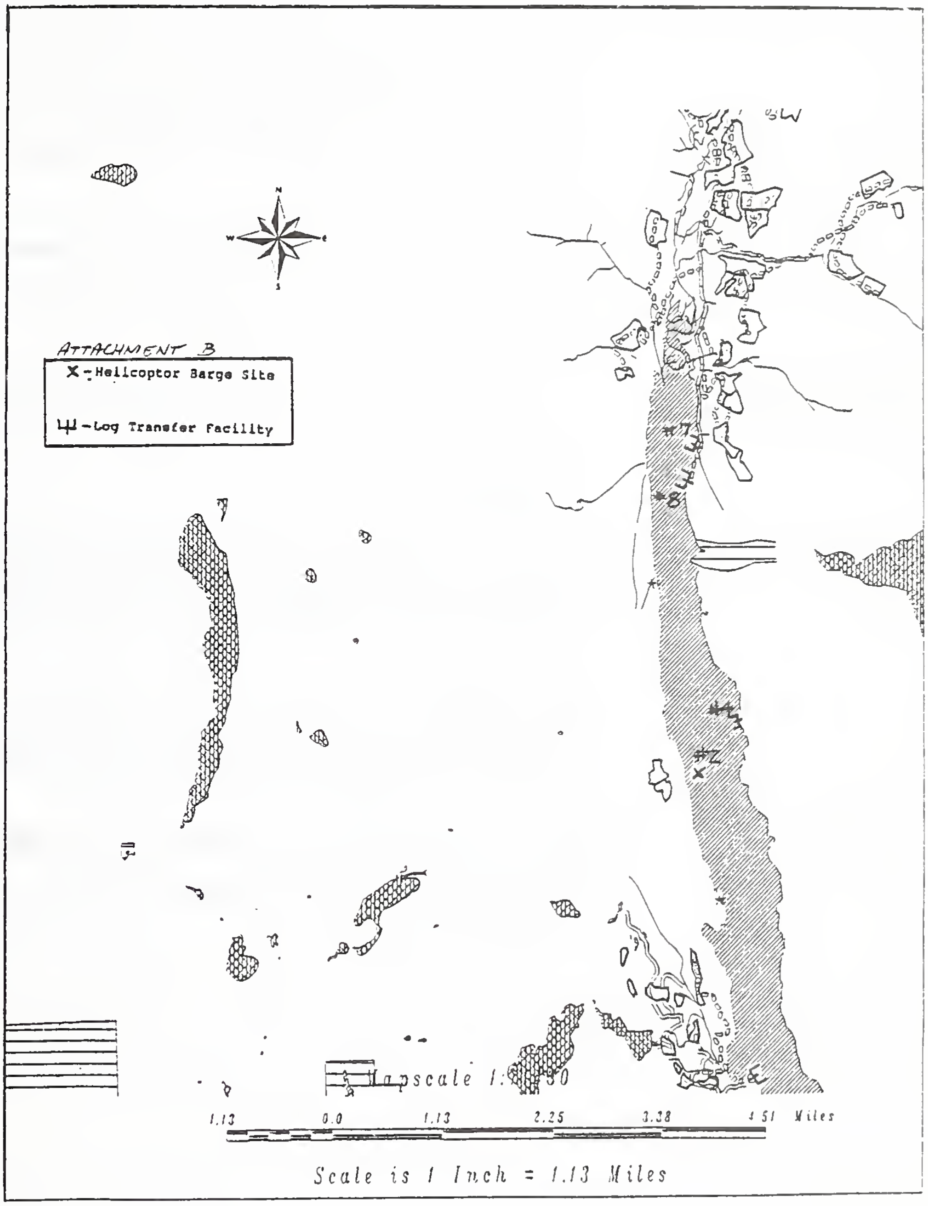
The helicopter transfer of logs to water transportation modes consists of moving logs from the harvest area directly to the water. The logs are placed in a containment area (bag boom), then moved by boom boat to the raft or sort yard. A modification of this system is to fly logs directly to a barge.

Each LTF requires a log transfer area, operations area, a small airplane and boat dock, an equipment off-loading ramp, and a log raft storage area. These facilities are generally located within close proximity of the LTF to reduce costs and retain impacts within a localized area.

Sites Considered in Detail

There were three sites considered in detail, others were eliminated for terrain or environmental reasons.

Figure Marine-2
Sites Considered in Detail



Carroll Inlet LTF No. 7 (preferred), is an existing site that would access timber from the Carroll Creek drainage. This site has been impacted by past timber harvest activities, both on the uplands and in the marine environment. This site was considered biologically acceptable by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. LTF No. 7 can be developed as an A-Frame lift-off system or a low-angle ramp. Analysis of the surveys since the DEIS has determined that a low angle ramp can be used. This site meets the Alaska Timber Task Force Guidelines (see Appendix G).

Carroll Inlet (LTF No. 8) is a proposed site that would access timber from the Carroll creek drainage. This site was considered biologically acceptable by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. LTF No. 8 would be developed as an A-Frame lift off system. This site meets the Alaska Timber Task Force Guidelines and may be within a forested wetland.

Sites Considered but Eliminated from Detailed Study

Carroll Inlet (LTF No. 4) is located on the east side of Carroll Inlet, south of the Swan Lake outfall. The site was eliminated because of the need to cross the Swan Lake outfall and power plant area with an access road.

Logging Camps

The Upper Carroll Project Area has limited suitable upland areas for land camps. Conversely, the area contains some protected bays and coves suitable for float camps.

Float Camps

Many historically used float camp sites, and some new sites, are expected to be used in implementation of this project. The number and locations of the sites will depend upon the number of logging and road construction contractors engaged in implementing the project. Additionally, camp configuration and type, such as barge or log floats, will influence the location. The operator will be required to obtain required state permits for camps.

Land Camps

Some previously used land-based camp sites, and some potentially new sites, are expected to be used in implementation of this project. As with float camps, camp configuration will influence the location.

The contractor/operator will be responsible for obtaining appropriate permits for camps.

Solid waste disposal will not be allowed on National Forest land (Forest Service policy, Ketchikan Area policy).

Effects of the Alternatives

Log Transfer Facilities

The number of existing and new LTFs required to harvest the timber scheduled in all action alternatives varies. Table Marine-3 displays the LTFs required for each alternative.

Table Marine-3
LTFs Required for the Alternatives

LTFs Required	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Existing Sites	2	1	1	1	1
Proposed Sites	0	1	1	1	1
Total	**2**	**2**	**2**	**2**	**2**

SOURCE: Oien 1996

Effects on Types of LTFs

LTFs can be either low-angle ramps or bulkhead type structures used for transferring logs from trucks to saltwater. Appendix G has a thorough evaluation of proposed LTFs in accordance with the Alaska Timber Task Force guidelines and in accordance with section 404(b)(1) of the Clean Water Act.

Two general types of facilities and their associated effects on the environment are analyzed. The first type of LTF is a low-angle ramp. This facility varies in direct impact to the intertidal area with rock riprap and fill from 0.05 acres to 0.5 acres.

The second type of facility considered in this analysis is a bulkhead facility with a lift-off system. The lift-off system may be either a single or double A-frame. The type of facility ranges in direct impact to the intertidal area with bulkhead construction and fill from 0.1 acres to 0.25 acres.

Of the two designs, the ramp design is approximately one-third the cost to construct, maintain, and operate. Maintenance of a timbered bulkhead facility would require replacement at 10-year intervals, thereby substantially increasing the costs of future harvests (Faris and Vaughan 1985). Concrete bulkheads can be substituted for timbered bulkhead structures, also at a higher cost. Table Marine-4 displays the construction and reconstruction costs associated with each LTF.

Another form of log transfer from land to water oriented transportation is aerial transport of logs from the harvest area directly to water or a barge. This method eliminates the need for truck haul and road development. However, this system is economically prohibitive except in specific situations.

Table Marine-4
Construction and Reconstruction Costs Associated with Proposed LTFs

	LTF No.	Transfer Method	Transfer Equipment Cost **	Site Development Cost	Total Cost
Site Construction:					
Carroll Inlet	7	Low angle ramp	0	80,000	80,000
Carroll Inlet ***	8	A-Frame	250,000	250,000	500,000
Reconstruction:					
Shrimp Bay *		A-Frame	0	0	0
Shelter Cove *		A-Frame	0	0	0

SOURCE: Oien 1996

* These sites were reconstructed, or will be reconstructed, under the Shelter Cove FEIS or the North Revilla FEIS.
** Transfer equipment costs are not included in cost of transportation system development costs.
*** This cost does not include the cost of additional new road construction to access the site.

Effects of LTFs on the Marine Benthic Habitat

During the transfer of logs from land to water, bark is sloughed off and may be deposited on the ocean bottom; bark also is continually sloughed off by agitation by wind and waves while the logs are in rafts. If the bark accumulates on the bottom, it can diminish habitat for bottom-dwelling crustaceans and molluscs, as well as hamper underwater vegetation used as food and rearing sites for marine fish and other organisms. All LTFs in the Project Area have been designed to maximize flushing suspended bark away from the LTF area to the open sea before it can accumulate on the bottom. In 1985, it was determined that discharge of bark into the water at an LTF was a discharge requiring a National Pollution Discharge Elimination System (NPDES) permit.

New LTFs are sited in accordance with the Alaska Timber Task Force Siting Guidelines and section 404(B)(1) of the Clean Water Act to mitigate the effects of LTFs on other resources and ecosystems. The existing LTF that is being reactivated generally meet the above State guidelines. LTFs will affect the marine benthic habitat (plants and animals that live in and on the bottom). Marine benthic habitat impacts are expected to be as follows:

Structural Embankment: estimated 0.23 acres affected per site
Site Bark Deposition: 1.0 acre zone of deposition per site
Raft Storage Bark Deposition: unknown

The marine benthic environment impacts are displayed in Table Marine-5.

Table Marine-5
Marine Benthic Impacts by Alternatives

Category	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Existing Number of Sites	2	2	2	2	2	2
Proposed Number of Sites	0	0	1	1	1	1
Acres Effected by Structural Embankment						
Total Number of Sites	2	2	3	3	3	3
Existing	0.46	0.46	0.23	0.23	0.46	.46
Proposed	0.00	0	0.46	0.46	0.23	.23
Total	**0.46**	**0.46**	**0.69**	**0.69**	**0.69**	**.69**
Estimated Acres Effected by Bark						
Existing	2.0	2.0	2.0	2.0	2.0	2.0
Proposed	0.0	0	1.0	1.0	1.0	1.0
Total	**2.0**	**2.0**	**3.0**	**3.0**	**3.0**	**3.0**

SOURCE: Oien 1996

Structural Embankment

All LTF types occupy approximately the same amount of bottom area. For instance, the ramp off-push in a ten percent grade system extends approximately 250 feet out into the water on a moderately sloped beach. This system is thus long and narrow. The ramp and A-frame systems use more shoreline and do not protrude out into the water as much as the float off-push in system. All systems cover about the same bottom area but in different configurations.

Site Bark Deposition

Two publications describe some of the general effects of LTFs and log storage on the marine benthic habitat. Sedell and Duval (1985) summarize the information available on the effects log transport and storage have on marine resources and fisheries. Faris and Vaughn (1985) examined log transportation and log storage in Southeast Alaska.

Shultz and Berg (1976) examined 32 existing LTF sites and found that 19 had bark accumulation, eight had no bark accumulation, and five had traces of bark. The extent of bark accumulation ranged from zero to 9.0 acres for 31 of the 32 sites. The 32nd site had accumulation of 182 acres that could not solely be attributed to log transfer activities. Faris and Vaughn (1985) reexamined the original data from Shultz and Berg (1976) and found that the average accumulation size was 1.96 acres for all sites excluding the 182-acre site. They speculate that bark and debris accumulation may be decreasing over time due to currents. No estimate was made on the length of time before bark accumulation was completely eliminated.

Faris and Vaughn (1985) also examined the extent of total damage to the marine benthic habitat in Southeast Alaska. Their results indicate that from the 90 currently permitted sites, a total of 176 acres would be affected (using the 1.96 acre average). This is .02 percent of the total estuarine area that is less than 60 feet deep. Moreover, when they examined all of the potential area of bark and debris accumulation from all permitted and proposed sites in Southeast Alaska, including all sites considered in the KPC Long-term Sale 1989-1994 EIS, they found that a total of 317 acres would be affected. This is 0.09 percent of the total estuarine area that is less than 60 feet deep in all of Southeast Alaska. This result corresponds with the conclusions of Sedell and Duval (1985) that the evidence of damage on important marine populations (bivalves, crabs and salmonids) was inconclusive because of the small area of impact due to log transfer facilities. This evidence resulted in development of the current siting guidelines (e.g., avoiding crab habitat, shallow areas at the heads of bay, etc.) and suggests that impacts would be minimal.

The major effect of bark and debris accumulation is that little neck clams and bay mussels have been shown to be eliminated when as little as four to five inches (10-13 cm) of bark accumulates (Freese and O'Clair 1987). Further, Colin and Ellis (1979) reported molluscs and several polychaetes were excluded by bark debris thicker than 2.5 cm, and that effects of bark may last several decades. From this evidence, it can be assumed that other plants and animals that live in and on the bottom would probably be at similar risk.

Concentrations of chemical lechates from bark have been shown to be toxic to salmon fry, crabs, and clams (O'Clair 1983). However, these toxic substances can settle in saltwater; therefore, these substances do not appear to be a major problem in open water where good circulation exists (Sedell and Duval 1985). The Alaska Timber Task Force Siting Guidelines for LTFs (Appendix G) attempts to mitigate the potential effects of bark dispersal and toxicity by: (1) locating LTFs in areas having the least productive inter-tidal and sub-tidal zones; (2) avoiding sensitive habitats; (3) avoiding shallow water; and (4) providing that LTFs should be located along or adjacent to straits, channels, or deep bays where currents are strong enough to disperse sunken or floating wood debris. Currently, all active LTFs receive a yearly underwater diving and sampling transect as required by the Environmental Protection Agency.

Certain dissolved substances (hydrogen sulfide and ammonia) recently have been shown to occur in open spaces between pieces of bark accumulated on the bottom (O'Clair and Freese 1988). O'Clair and Freese also note that it is not clear whether other toxic substances not measured in the study occur within bark accumulations. These substances do not enter the water above the bark. However, if Dungeness crabs burrow into the bark deposit, it has been demonstrated that their reproductive ability, eating habits, and overall survival can be affected. It should be noted that this type of effect has been demonstrated in only one bark accumulation field (Rowan Bay LTF) and that, in general, Dungeness crabs were not found in bark accumulations at a number of other LTF locations. It is not known whether these effects would occur for other burrowing crab species. Since king crabs do not burrow, it is not clear whether this species is affected by bark and debris accumulation at LTF sites.

Raft Storage Bark Deposition

The other potential effects associated with LTFs are from log rafts and log storage in saltwater. The area under a log raft may be affected by bark accumulations with effects similar to but not as concentrated as those discussed for LTFs. In addition, if the raft is stored in a bay or cove for a long period of time, marine algae may be affected by shading. Occasionally, rafts stored in shallow depths may ground on the bottom. This would cause mechanical disruption or compaction of inter- and subtidal bottom habitats. This would be a short-duration effect because recolonization would begin shortly after the raft refloated, unless the site were repeatedly used and log rafts frequently grounded. Proposed and existing log storage areas in the Project Area are deep enough and are not expected to ground.

Barge LTFs

Barge LTFs probably would have less effect on the marine environment than rafting LTFs, although no studies are available for comparison. The rock embankment associated with the facility would be longer and slightly wider at the seaward end. The additional length and width would eliminate a larger intertidal area than a rafting LTF breakwater. The longer length and wider seaward end in deeper water would require dredging and filling in the subtidal area Bark and debris would accumulate only in a small area around the extreme seaward end of the facility.

Helicopter to Log Boom or Barge LTF

Helicopter to log boom or barge LTF would probably have less effect on the marine environment. Helicopter to log boom would be more impacting than to a barge. However, the log boom can be located in deep water to avoid bark deposition and embankment in the higher value shallow areas. Helicopter to barge would eliminate bark deposition and embankment in the marine environment.

LTF Selection Rationale

Numerous LTFs were considered for the Upper Carroll Project Area. The rationale for individual areas is displayed in the analysis for the Clean Water Act, 404(b)(1) permit (Appendix E). Further analysis has been done on the two sites that were considered for the timber volume tributary to the Carroll Creek drainage. The two sites have had additional topographic surveys completed on the sites to determine the best site and type of LTF that will have the least environmental impacts and also have economic viability. LTF No. 7, the existing LTF site, is at the head of Carroll Inlet on the east side. This site has been impacted previously due to harvest occurring in the 1960s. LTF No 8 (site) is located 2000 feet to the south of LTF No. 7; a road will be need to be constructed from LTF No. 7 to access this area. The access route lies on some excessively steep side slopes adjacent to the shoreline of Carroll Inlet. Both sites were evaluated for development of all three types of log transfer facilities; low angle ramp system, A-frame system, and log barge loading system.

Table Marine-6 displays the effects on the marine environment and the costs associated with each LTF system. Additional analysis of the impacts of each type of LTF on the economic viability of each alternative is included in Chapter 3-Timber.

Table Marine-6
Effects of LTF Systems on the Marine Environment and Their Associated Costs

	LTF No. 7				LTF No. 8		
LTF System	**Acres Marine Habitat**	**Acres Upland Area**	**Cost (M$)**	**LTF System**	**Acres Marine Habitat**	**Acres Upland Area**	**Cost (M$)**
A-Frame	0.40	0.20	250	A-Frame	0.20	0.60	450 *
Low Angle Ramp	0.20	0.40	80	Low Angle Ramp	N/A	N/A	N/A*
Barge	0.30	1.00	400	Barge	0.20	0.90	588 *

SOURCE: Oien 1996

* Transfer equipment costs are not included in cost of transportation system development costs.

Fisheries

The effects of LTFs on fisheries resources have not been quantified. It is unlikely that any effects on returning adult fish would occur unless a LTF to raft storage area was immediately adjacent to an anadromous fish stream and caused blockage of entry into the stream. Juvenile pink and chum salmon that spend several months immediately after out-migration in protected bays and coves would be more likely to be affected by activities in the marine environment. These small fish are highly mobile as they actively feed on marine invertebrates. Some of their preferred food items live on the surface of the bottom. Bark accumulation and the area under the embankment of a standard breakwater eliminates a small portion of the habitat of those food items but is unlikely to cause measurable adverse consequences.

It has been hypothesized that the breakwater usually associated with a LTF structure, regardless of whether a raft or barge, can cause greater mortality of pink and chum juveniles because they are forced to move into deeper water where more predators consume them. It is not known whether this is a major source of mortality in addition to the naturally low survival rate attributed to early marine life stage of juvenile pink and chum salmon. Because barge LTFs require longer breakwaters, the probability of this effect may be increased.

There is no formal documentation that LTF structures or activities associated with their use, conflict with commercial fishing near the facility. If a facility were located in a small bay or cove, it is possible that there could be some difficulty maneuvering around log rafts or moored barges to get to favored fishing sites. No adverse consequences on commercial fishing or subsistence uses or marine resources are anticipated as the result of LTF location.

Camps associated with a LTF site can cause additional use of fisheries and marine sources. There is no data currently available on the amount of additional use occurring at various camp locations in the study area. The competition for resources at or near logging camp locations would probably increase. There is currently little or no information to indicate that resource allocation problems have occurred as the result of a logging camp. The Board of Fisheries and Game can control the amount of harvest by setting bag limits, shortening season lengths, or by instituting a complete closure of a fishery. If resource problems arise because of increased resource pressure due to a logging camp, the Forest Service would aid the Alaska Department of Fish and Game in attempting to resolve the problem. However, it is unlikely that all allocation or utilization would progress far enough to cause adverse consequences on the fisheries or marine resource.

Wildlife

From a wildlife perspective, there are two types of effects associated with a LTF and camp. First, there is the potential loss of wildlife habitat due to clearing for the camp, sort yard, and associated facilities. The second possible disturbance to wildlife is a result of increased human activity associated with the camp.

The amount of habitat lost is relatively minor. Whenever possible, camps and sort yard facilities are located away from the highest quality habitat. The differences between a slide facility and barge facility are inconsequential. The objectives are to avoid eagle nest sites and estuarine habitat.

The overall effects of disturbance of wildlife-use patterns are generally minor. Most wildlife species generally adapt to increased human use quickly.

Human activity associated with the camps and facilities may effect wildlife. This includes disturbance of wildlife-use patterns, increased harvest, and increased bear-human encounters.

An increase in the number of people in an area would generally increase the use of and competition for wildlife resources. However, actual harvest levels can be monitored and regulated. The influx of additional people into an area appears to have a greater potential to affect the existing users of the area than wildlife species. Wildlife populations may be affected by the LTFs or logging camps proposed in any of the alternatives. For additional information on the effects of the proposed alternatives on existing users, see the ANILCA, Section 810, Subsistence Evaluation and Finding in the Subsistence section of this chapter.

Visual Resources

The large size, linear bold shape, and saltwater location of LTFs generally dominate the landscape when viewed within the foreground distance (less than one-quarter mile). Their relatively low profile, however, helps mitigate the negative visual impacts when viewed from the middleground (one-quarter mile to five miles). Visual contrasts of openings or clearings for sort yards and land camps, located on fairly level or gently sloping sites, help absorb much of their visual impact when viewed from saltwater viewpoints.

There are no new sort yard areas or camp areas considered in any of the alternatives for this Project Area. It is expected that most camps will consist of floating camps. Accordingly, upland development will consist of structures such as maintenance shops and fuel storage tanks. These facilities will have minimal permanent visual resource impact.

Long Term Productivity

This section compares the short-term effects of developing LTFs in the intertidal area to long-term accessibility (for timber management) and productivity in the area. Without a means to transfer logs into saltwater, the long-term opportunity to manage the uplands for commercial timber is lost. If LTFs were not approved by permitting agencies, the volume tributary to those facilities would not be available to meet contractual obligation.

It is assumed that other resources would have similar management opportunities with or without access to the uplands from saltwater (by an LTF). Table Marine-7 compares the number of acres potentially affected by each LTF to the number of acres of suitable timber tributary for each location.

Short-term use of 3.69 acres of estuarine habitat, all of which occurs in large estuaries, would provide access to 5,654 acres of land suitable for timber production. This roughly equates to 140 MMBF to be available to meet commitments to the Ketchikan Area timber sale program.

Table Marine-7
Comparison of Short-term Uses to Long-term Productivity for the Estuarine System

LTF Name	VCUs Served by LTF	Acres Estimated Impact	Acres of Potential Harvest 2000-2004	Acres of Future Harvest 2004-2140
Shrimp Bay	737	1.23	370	1,016
Shelter Cove	746	1.23	50	340
Carroll Inlet	744, 737	1.23	1,576	4,298

SOURCE: Oien 1996

Other Environmental Considerations

Probable Adverse Environmental Effects that Cannot be Avoided

Implementation of any action alternative would result in some adverse environmental effects that cannot be effectively mitigated or avoided if the proposed action is to take place. The interdisciplinary procedure used to identify specific harvest units and roads was designed to eliminate or lessen the significant adverse consequences. In addition, the application of standards and guidelines, BMPs, mitigation measures, and a monitoring plan are intended to further limit the extent, severity, and duration of these effects. The specific environmental effects of the alternatives were discussed earlier in this chapter, and mitigation measures are described in Chapter 2. Although the formulation of alternatives included avoidance of potentially adverse environmental effects, some adverse impacts to the environment which cannot be completely mitigated may occur.

Although standards and guidelines, BMPs, and monitoring plans are designed to prevent significant adverse effects to soil and water, the potential for adverse impacts does exist. Sediment production would occur as long as roads are being built and timber is harvested. Sediment would be produced by surface erosion, channel erosion, and mass movement.

Disturbance, displacement, or loss of fish and wildlife may occur as a consequence of habitat loss and increased human activity in the Project Area. New road construction and the human activities associated with new access to areas previously unroaded would result in impacts to fish and wildlife. Improved access into areas that previously had limited roads would have similar effects. The proposed activities would increase competition for subsistence resources.

Ground-disturbing activities could temporarily increase sediment loads in some streams. This could displace fish, reduce anadromous and resident fish reproductive success, and alter aquatic invertebrate populations. The portion of a stream bed occupied by a culvert or other crossing structure would be lost as fish habitat.

Both the amount and distribution of mature and old-growth stands would be reduced through implementation of any action alternative. The rate and severity of adverse impacts varies by alternative. Because some wildlife species rely on habitat conditions provided by old-growth stands, the reduction in the populations of some wildlife species can be expected. As old-growth and mature timber stands are converted to young even-aged stands, the capability of the Project Area to provide optimal habitat for old-growth dependent species would be reduced.

Timber harvest and road construction in areas that are currently unroaded would alter natural characteristics of these areas. This would modify the recreational experiences that are offered by these areas. Both Primitive and Semi-Primitive recreation opportunities will be lost by these actions. In addition, these development activities would result in a loss of opportunity to consider these areas in future revisions of the Forest Plan for designation as wilderness, as roadless areas, research natural areas, or for other purposes requiring natural characteristics.

The natural landscape would appear visually altered by timber harvest, roads, and structures particularly where logging activity is visible from travel routes and use areas. These adverse effects would eventually be mitigated by natural regrowth of vegetation. Other impacts on the natural appearance of the landscape include roads and structures which are highly visible despite efforts to blend them with landforms and mitigate the effect by landscaping.

The intensity and duration of these effects depends on the alternative and the mitigation measures applied to protect the resources. Most unavoidable effects are expected to be short term (usually less than two to five years). In all cases, the effects would be managed to comply with established legal limits, such as maximum time for regeneration. To reduce these effects, monitoring procedures and mitigation measures have been planned for those areas which may be affected. Specific mitigation measures are documented in the unit and road cards.

Some adverse effects are of a transitory type. For example, air quality may diminish on a recurring, though temporary, basis due to road construction, timber harvest, timber hauling and recreation traffic on untreated roads, and due to the operation of internal combustion engines. Where they occur, these activities may have localized temporary adverse effects on air quality.

Relationship Between Short-term Uses and Long-term Productivity

All alternatives would come under the mandate of the Multiple Use and Sustained Yield Act of 1960, which requires the Forest Service to manage Forest System lands for multiple uses (including timber, recreation, fish and wildlife, range, and watershed). All renewable resources are to be managed in such a way that they are available for future generations. The harvesting and use of standing timber can be considered a short-term use of a renewable resource. As a renewable resource, trees can be reestablished and grown again if the productivity of the land is not impaired.

Maintaining the productivity of the land is a complex, long-term objective. All alternatives protect the long-term productivity of the Project Area through the use of specific standards and guidelines, mitigative measures, and BMPs. Long-term productivity could change as a result of various management activities proposed in the alternatives. Timber management activities would have direct, indirect, and cumulative effects on the economic, social, and biological environment.

Soil and water are two key factors in ecosystem productivity, and these resources would be protected in all alternatives to avoid damage that could take many decades to rectify. Sustained yield of timber, wildlife habitat, and other renewable resources all rely on maintaining long-term soil productivity. Quality and quantity of water from the Project Area may fluctuate as a result of short-term uses, but no long-term effects to the water resource are expected to occur as a result of timber management activities.

All alternatives would provide the fish and wildlife habitat necessary to contribute to the maintenance of viable, well-distributed populations of existing native and desired non-native vertebrate species. The abundance and diversity of wildlife species depends on the quality, quantity, and distribution of habitat, whether used for breeding, feeding, or resting. Management Indicator Species (MIS) are used to represent the habitat requirements of all fish and wildlife species found in the Project Area. By managing habitats and populations of indicator species, the other species associated with the same habitat would also benefit. The alternatives provide standards, guidelines, and mitigation measures for maintaining long-term habitat and species productivity. The alternatives vary in the risk presented to both wildlife habitat and habitat capability.

Timber rotations are normally over a 100-year or longer rotation, depending upon site quality. To ensure adequate production of timber, harvest has been scheduled to allow the earliest cut stands to mature into merchantable timber before the planned harvest of original stands is complete. When the first rotation is complete, mature timber stands would be harvested again on a new rotation. Management of the timber resource on these rotations could affect long-term productivity, depending on the intensity of silvicultural practices. Projected timber rotation lengths are not anticipated to affect long-term productivity. Mitigation measures are planned under all the alternatives to ensure future availability of other renewable resources as well.

Opportunities for dispersed recreation use, including hiking, camping, and fishing, would be maintained and increased for future generations. The setting in which these activities occur varies by alternative, but the long-term potential for the Project Area to provide a spectrum of recreation opportunities would be maintained in all alternatives.

Irreversible Commitments of Resources

Irreversible commitments are decisions affecting non-renewable resources such as soils, wetlands, unroaded areas, and cultural resources. Such commitments are considered irreversible because the resource has deteriorated to the point that renewal can occur only over a long period of time or at a great expense or because the resource has been destroyed or removed.

The construction of Arterial and Collector roads, to provide access to the Forest, is an irreversible action because of the time it takes for a constructed road to revert to natural conditions. Irreversible actions also include the associated rock quarries which are developed in conjunction with these roads. Alternative 1 will have no new road construction, while Alternatives 2, 3, 5, 6, and 7 would construct roads and quarries to harvest units as described under the Transportation section of this Chapter. This will require that up to 80 acres of ground be irreversibly committed to rock quarries and up to 1.5 million cubic yards of rock fill to be placed for road construction and reconstruction.

There are two roadless areas as identified in the TLMP RSDEIS (1996a) that may be affected by the Upper Carroll project. A decision to develop these roadless areas would mean that their primitive character in terms of opportunities for solitude, remoteness, and development of wilderness skills would be foregone. Alternative 1 would have no new roads constructed or units harvested, while Alternatives 2 through 6 would construct roads and harvest timber as described in the Roadless Areas section of this chapter. Implementation of an action alternative would result in an irreversible loss of portions of these roadless areas.

Old-growth habitat lost due to logging can be considered an irreversible effect since it is not expected to regain old-growth characteristics for at least 150 years. Alternative 1 would not harvest any old growth, while Alternatives 2 through 7 would harvest old-growth timber as described in the Silviculture, Timber, Wildlife, and Biodiversity sections of this chapter.

Loss of soil due to erosion and mass failures are irreversible commitments of resources. However, due to the incorporation of BMPs, Forest Plan Standards and Guidelines, and mitigation measures specified in this document, it is not anticipated that there would be any significant soil loss under any alternative.

Loss of cultural resource sites resulting from accidental damage or vandalism would be an irreversible commitment of resources. The standards and guidelines, survey methodology prior to activities, and mitigation measures specified in this document provide reasonable assurance that there would be no irreversible loss of cultural resources.

Irretrievable Commitments

Irretrievable commitment of natural resources means loss of production or use of resources due to management decisions made in the alternative. This represents opportunities foregone for the period of time that the resource cannot be used.

Foregoing timber harvest opportunities at this time in certain areas due to resource concerns or economics may represent an irretrievable commitment of resources because that volume cannot be harvested. The commitment is irretrievable rather than irreversible, because future entries could harvest those areas if they are still classified as part of the suitable timber base.

The reduction in the visual quality of an area due to timber harvesting will be an irretrievable commitment of resources. The commitment is irretrievable since viewsheds will typically heal from a visual quality standpoint after about 40 years. After this time, the second-growth trees will have the color and height needed so as not to be evident to the casual observer. Alternative 1 will have no irretrievable commitment of visual quality. Alternatives 2 through 7 will irretrievably commit visual resources due to timber harvesting activities.

Possible Conflicts with Plans and Policies of Other Jurisdictions

The regulations for implementing NEPA require a determination of possible conflicts between the proposed action and the objectives of Federal, State, and local land-use plans, policies, and controls for the area. The major land-use regulations of concern are the Coastal Zone Management Act (CZMA), Section 810 of ANILCA, and the State of Alaska's Forest Practices Act. A discussion of each of these determinations is presented below.

Coastal Zone Management Act of 1976 (CZMA)

The CZMA was passed by Congress in 1976 and amended in 1990. This law requires Federal agencies conducting activities or undertaking development affecting the coastal zone to ensure that the activities or developments are consistent with approved state coastal management programs to the maximum extent practicable. The State of Alaska passed the Alaska Coastal Management Act in 1977, to establish a program that meets the requirements of the CZMA. It contains the standards and criteria for a determination of consistency for activities within the coastal zone.

The Forest Service has evaluated the alternatives to ensure that the activities and developments affecting the coastal zone are consistent with approved coastal management programs to the maximum extent practicable. The standards and guidelines for timber management activities in the Upper Carroll Project Area meet or exceed those indicated in the Alaska Forest Practices Act and the Alaska Coastal Management Program (ACMP).

Evaluation of the proposed activities against standards and guidelines for activities within the coastal zone results in a finding that these activities are consistent with the ACMP to the greatest extent practicable. In accordance with the Memorandum of Understanding and Alaska statutes, the State of Alaska Office of Governmental Coordination performed a preliminary consistency review of this EIS.

Alaska National Interest Lands Conservation Act of 1980 (ANILCA)

Under Section 810 of ANILCA, agencies are required to evaluate the effects of proposed actions on subsistence uses of Federal land and determine if the proposed action may significantly restrict subsistence opportunities. Refer to the Subsistence section of this chapter for the evaluation of impacts to subsistence use as a result of the alternatives.

State of Alaska's Forest Practices Act of 1990

On May 11, 1990, the governor approved the legislature's major revision of the State's Forest Practices Act (FPA). The revised act significantly increases the State's role in providing protection and management for important forest resources on State and private lands. The revised FPA will also affect National Forest management through its relationship to the ACMP and the Federal CZMA (see above discussion).

For National Forest timber operations, such as proposed for the Upper Carroll project, the effect of the revised FPA is essentially two-fold. First, it clarifies that the revised FPA regulations are the standard which must be used for evaluating timber harvest activities on Federal lands for purposes of determining consistency to the maximum extent practicable with the Alaska Coastal Zone Management Program. Secondly, it calls for minimum 100-foot buffers on all Class I streams and recognizes that consistency to the maximum extent possible for purposes of the ACMP is attainable in Federal timber harvest activities using specific methodologies which may differ from those required by the revised FPA or its implementing regulations.

The Forest Service has evaluated the alternatives to ensure that the activities and developments affecting the coastal zone are consistent with approved coastal management programs to the maximum extent practicable. The layout of all proposed harvest units comply with the TTRA requirements for stream buffers which exceed the stream buffer requirements in the Alaska FPA.

The Forest Service has evaluated all Project Alternatives (including the ROD) prior to completion of the FEIS and the ROD issuance to ensure that the activities and developments specifically covered by the FPA are consistent with its provisions to the maximum extent possible.

Energy Requirements and Conservation Potential of Alternatives

The implementation of the proposed actions in the Project Area will require the expenditure of energy (e.g., fuel consumption). The amount of energy used varies by alternative based on timber volume harvested and miles of road constructed or reconstructed. The direct effect of the alternatives on energy requirements would be attributed to timber harvest, road construction and reconstruction, and travel necessary to prepare and administer the timber sale. Indirect energy requirements include processing wood products and the transport of the products to secondary processors and consumers. It has been determined that estimating indirect energy requirements used by secondary processors and consumers are unattainable as well as beyond the scope of this document. They are therefore not displayed.

Fuel Consumption

Fuel consumption requirements were estimated as follows:

Timber Sale Preparation and Administration, 1.56 gallons/MBF
Cable Logging, 2 gallons/MBF
Helicopter Logging, 8 gallons/MBF
Load, Haul, Dump and Tow, 8 gallons/MBF
Road Construction, 4,000 gallons/mile
Road Maintenance, 20 gallons/mile

The estimated total fuel consumption required for each alternative is displayed in Table Other-1.

Table Other-1
Estimated Direct Fuel Consumption by Alternative

	Alt. 1	Alt. 2	Alt. 3	Alt. 5	Alt. 6	Alt. 7
Thousands of gallons	0	1,037	490	825	515	333
Average gallons/MBF	0	16.9	14.7	16.2	15.9	18.0

SOURCE: Nightingale 1996

Note: The estimated fuel consumption for timber harvest activities is based on consumption per MBF of sawlog volume.

Conservation Potential

To conserve fuel and/or minimize harvesting costs, the Forest Service has undertaken studies and allowed experimentation with new harvesting equipment and techniques. Shovel yarding is estimated to use 2.7 gallons of fuel per MBF, which is almost a gallon more per MBF than for cable yarding; however, savings are realized in labor costs. Labor cost per MBF is based on a crew size of 1-2 people for shovel yarding compared to an average of four people for cable yarding.

The use of low tire pressure equipment or central tire inflation (CTI) during road construction and logging has also shown to decrease costs during studies nationwide and on the Stikine Area of the Tongass National Forest. Studies on Mitkof Island indicate that 10 to 14 percent less rock was needed during road construction, resulting in cost savings of approximately $450,000. It is predicted that costs for rock replacement/road maintenance, log truck fuel, and tire repair and replacement will be decreased. Cost savings have proven to be substantial enough that the Forest Service provides a contract clause allowing a reduction in rock replacement deposits when low tire pressure equipment is used.

The use of cable yarding equipment fitted with mechanical or hydraulic interlocking drums provides the ability to decrease yarding expense as the throttle and brake do not have to be ridden simultaneously to provide suspension for a turn of logs.

Natural or Depletable Resource Requirements and Conservation Potential

All alternatives considered in detail are designed to conform to applicable laws and regulations pertaining to natural or depletable resources, including minerals and energy resources. Regulation of mineral and energy activities on the National Forest, under the U.S. Mining Laws Act of 1872, and the Mineral Leasing Act of 1920, is shared with the Bureau of Land Management (BLM). The demand for access to National Forest system lands for the purpose of mineral and energy exploration and development is expected to increase over time.

The action alternatives propose road construction that will increase opportunities for acccss to the National Forest within the Project Area. This increased access may result in increased activity with regard to both known and potential mineral or energy resource occurrences. The actual potential for increased mineral or energy resource activity in the Project Area is not known, nor can an accurate estimate be made.

Urban Quality, Historic and Cultural Resources

The Project Area contains no urban areas. Therefore, the only applicable concern under this topic is with historic and cultural resources. The goal of the Forest Service's Cultural Resource Management Program is to preserve significant cultural resources in their field setting and ensure they remain available in the future for research, social/cultural purposes, recreation, and education. The direct, indirect, and cumulative effects of the alternatives on cultural resources have been evaluated. The result of this evaluation is the determination that there are adequate standards, guidelines, and procedures to protect cultural resources and to meet the goals of the Cultural Resource Management Program. Cultural resources are discussed further in the Cultural section of this chapter.

Consumers, Civil Rights, Minorities, and Women

All Forest Service actions have the potential to produce some form of impact, positive and/or negative, on the civil rights of individuals or groups, including minorities and women. The need to conduct an analysis of this potential impact is required by Forest Service Manual and Forest Service Handbook direction. The purpose of the impact analysis is to determine the scope, intensity, duration, and direction of impacts resulting from a proposed action. For environmental or natural resource actions, such as proposed for the Project Area, the civil rights impact analysis is an integral part of the procedures and variables associated with the social impact analysis. This analysis is discussed in the Socio-economic section of this chapter.

The effect of the alternatives on consumers is reflected in the discussion of the various goods and services supplied as a result of the proposed actions. This analysis occurs throughout the chapter as an integral part of the analysis of the effects on other components of the environment.

Prime Farmland, Rangeland, and Forest Land

All alternatives are in keeping with the intent of Secretary of Agriculture Memorandum 1827 for prime land. The Project Area does not contain any prime farmlands or rangelands. Prime forest land does not apply to lands within the National Forest System. In all alternatives, lands administered by the Forest Service would be managed with a sensitivity to the effects on adjacent lands.

Threatened and Endangered Species, and Critical Habitat

There will be no adverse impacts to any Federally listed threatened or endangered species or to critical habitat as a result of this project. No endangered or threatened wildlife species are known to occur in the Project Area, although humpback whales and Steller sea lions are occasionally found in waters bordering the Project Area. The discussion of the effects of the alternatives on threatened, endangered, or sensitive species is presented in the Threatened and Endangered Species section of this chapter.

Chapter 4

Lists

Outline

List of Preparers

The following is a list of contributors to this EIS. Other Forest Service employees contributed to the completion of this document through their assistance in support functions. Their help is greatly appreciated.

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Forest Engineering Institute, Oregon State University, 1992
Certified Tree Measurement Specialist, 1983
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Glossary

Access
The opportunity to approach, enter, and make use of public lands.

Access Management
Acquiring rights and developing and maintaining facilities needed by people to get to and move through public lands (physical attributes).

Active Channel
Unstable portion of a stream where stream channels are frequently changing course.

Adfluvial Fish
Species of populations of fish that do not go to sea, but live in lakes, and enter streams to spawn.

Aelvin
Young salmon that are still attached to the yolk sac, which provides nourishment.

Aerial Harvest Systems
Harvesting methods in which the cut logs are moved from the stump to the loading area or log deck without touching the ground, for example helicopter logging.

Aggradation
The process of building up a land surface by deposition.

Alaska National Interest Lands Conservation Act (ANILCA)
Passed by Congress in 1980, this legislation designated 14 National Forest wilderness areas in Southeast Alaska. The Alaska National Interest Lands Conservation Act of December 2, 1980. Public Law 96-487, 96th Congress, 94 Stat. 2371-2551. In Section 810 requires evaluations of subsistence impacts before changing the use of these lands.

Alaska Native Claims Settlement Act (ANCSA)
Public Law 92-203, 92nd Congress, 85 Stat. 2371-2551. Approved December 18, 1971, ANCSA provides for the settlement of certain land claims of Alaska natives and for other purposes.

Allowable Sale Quantity (ASQ)
ASQ refers to the maximum quantity of timber that may be sold each decade from the Tongass National Forest. This quantity, expressed as a board foot measure, is calculated per timber utilization standards specified in the Alaska Regional Guide, the number and type of acres available for timber management, and the intensity of timber management. The ASQ was calculated at 4.5 billion board feet per decade for the Tongass National Forest.

Alluvial Fan
A cone-shaped deposit of organic and mineral material made by a stream where it runs out onto a level plain or meets a slower stream.

Alluvium
Material deposited by rivers or streams, including the sediment laid down in river beds, flood plains and at the foot of mountain slopes and estuaries.

Alpine
Parts of mountains above tree growth and/or the organisms living there.

Alternative
One of several policies, plans, or projects proposed for decision making.

Anadromous Fish
Anadromous fish (such as salmon, steelhead, and sea run cutthroat trout) spend part of their lives in freshwater and part of their lives in saltwater.

Anadromous Species
One whose individuals are born in freshwater but migrate to and feed in the sea before returning to freshwater to breed.

Aquatic Habitat Management Unit (AHMU)
A mapping unit that displays an identified value for aquatic resources. It is a mechanism for carrying out aquatic resource management policy.

Class I AHMU: Streams with anadromous or high-quality sport fish habitat. Also included is the habitat upstream from migration barriers known to have reasonable enhancement opportunities for anadromous fish.

Class II AHMU: Streams with resident fish populations and generally steep (6 to 15 percent) gradient (can also include streams from 0 to 6 percent gradient where no anadromous fish occur). These populations have limited sport fisheries values and are separate from the high-quality sport fishing systems included in Class I. They generally occur upstream of migration barriers or are steep gradient streams with other habitat features that preclude anadromous fish use.

Class III AHMU: Streams with no fish populations but have potential water quality influence on the downstream aquatic habitat.

Background
The distant part of a landscape. The seen or viewed area located from three or five miles to infinity from the viewer. (See "Foreground" and "Middleground".)

Beach Fringe Use Area
Non-forested wildlife use areas that occur from the intertidal zone inland 500 feet and islands of less than 50 acres. Forested wildlife use areas that occur from the intertidal zone inland 600 feet and islands of less than 50 acres.

Bedload
Sand, silt, and gravel, or soil and rock debris rolled along the bottom of a stream by the moving water.

Benthic
Refers to the substrate and organisms in and on the bottom of a body of water.

Best Management Practice (BMP)
Practices used for the protection of water quality. BMPs are designed to prevent or reduce the amount of pollution from nonpoint sources or other adverse water quality impacts while meeting other goals and objectives. BMPs are standards to be achieved, not detailed or site specific prescriptions or solutions. BMPs as defined in the USDA Forest Service Soil &Water Conservation Handbook are mandated for use in Region 10 under the Tongass Timber Reform Act.

Biological Diversity (Biodiversity)
The variety of life in all its forms and at all levels. This includes the various kinds and combinations of: genes; species of plants, animals, and microorganisms; populations; communities; and ecosystems. It also includes the physical and ecological processes that allow all levels to interact and survive. The most familiar level of biological diversity is the species level, which is the number and abundance of plants, animals, and microorganisms.

Biological Potential
The maximum possible output of a given resource limited only by its inherent physical and biological characteristics.

Biomass
The total quantity, at a given time, of living organisms of one or more species per unit area or all of the species in a community.

Biotic
Refers to life, living. See also, abiotic.

Blowdown
See windthrow.

Board Foot (BF)
A unit of wood 12" X 12" X 1". One acre of commercial timber in Southeast Alaska on the average yields 28,000-34,000 board feet per acre (ranging from 8,000-90,000 board feet per acre). One million board feet (MMBF) would be the volume of wood covering one acre two feet thick. One million board feet yields approximately enough timber to build 120 houses or 75,555 pounds of dissolving pulp.

Bole
Trunk of the tree.

Braided Streams or Channels
A stream flowing in several dividing and reuniting channels resembling the strands of a braid, the cause of division being the obstruction by sediment deposited by the stream.

Broadcast Burning
Burning of an area that has been clearcut to remove logging slash from the site. Broadcast burning is done to prepare sites for regeneration or improve wildlife habitat.

Brush Disposal
Cleanup and disposal of slash and other hazardous fuels within the forest or project areas.

Buffer
Tongass Timber Reform Act (TTRA) requires that timber harvest be prohibited in an area no less than 100 feet on each side of all Class I streams and Class II streams which flow directly into Class I streams. This 100-foot area is known as a buffer.

Cant
A log partly or wholly cut and destined for further processing.

Capability
An evaluation of a resource's inherent potential for use.

Carryover
Timber volume designated for harvest in a five-year operating period but not harvested during that period. It is available, therefore, for subsequent five-year operating periods.

Channel Migration
Movement of a stream or river channel within a floodplain area usually over an extended period of time.

Clearcut
The harvesting in one cut of all trees on an area. The area harvested may be a patch, strip, or stand large enough to be mapped or recorded as a separate class in planning for sustained yield. Clearcut size on the Tongass National Forest is limited to 100 acres, except for specific conditions noted in the Alaska Regional Guide.

Climax
A community of plants and animals which is relatively stable over time and which represents the late stages of succession under current climate and soil conditions.

Code of Federal Regulations (CFR)
A codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government.

Commercial Forest Land (CFL)
Productive Forest land that is producing or capable of producing crops of industrial wood and is not withdrawn from timber utilization by statute or administrative regulation. This includes areas suitable for management and generally capable of producing in excess of 20 cubic feet per acre of annual growth or in excess of 8,000 board feet net volume per acre. It includes accessible and inaccessible areas.

- *Normal CFL:* Timber that can be economically harvested with locally available logging systems. Composed of two categories:
  - *Standard:* Timber that can be economically harvested with locally available logging systems, such as highlead or short-span skyline.
  - *Special:* Timber that is in areas where special consideration is needed to protect other resources but can be harvested with locally available logging systems.
- *Non-standard CFL:* Timber that cannot be harvested with locally available logging systems and would require the use of other logging systems such as helicopter or long-span skyline.

Commercial Thinning
Thinning a stand where the trees to be removed are large enough to sell.

Confluence
The point where two streams meet.

Corridor
Connective links of certain types of vegetation between patches of suitable habitat which are necessary for certain species to facilitate movement of individuals between patches of suitable habitat. Also refers to transportation or utility rights-of-way.

Cover
Refers to trees, shrubs, or other landscape features that allow an animal to partly or fully conceal itself.

Critical Habitat
Specific terrain within the geographical area occupied by threatened or endangered species. Physical and biological features that are essential to conservation of the species and which may require special management considerations or protection are found in these areas.

Crown
The tree canopy. The upper part of a tree or woody plant that carries the main branch system and foliage.

Cruise
Refers to the general activity of determining timber volumes and quality as opposed to a specific method.

Cull Logs
Trees that do not meet certain quality specifications.

Culmination Mean Annual Increment (CMAI)
The point at which a tree (or stand) achieves its highest average growth, based on expected growth according to the management intensities and utilization standards assumed in the Forest Plan.

Cultural Resources
Historic or prehistoric objects, sites, buildings, structures, and their remains, resulting from past human activities.

Cumulative Effects
The impacts on the environment resulting from additional incremental impacts of past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions occurring over time.

Cutover
Areas harvested recently.

DBH (DBH)
Diameter Breast Height. The diameter of a tree measured 4 feet 6 inches from the ground.

Debris Avalanche
The sudden movement downslope of the soil mantle; it occurs on steep slopes and is caused by the complete saturation of the soil from prolonged heavy rains. Also known as a debris slide.

Debris Flow
A general term for all types of rapid movement of debris downslope.

Debris Torrents
Landslides that occur as a result of debris; avalanche materials which either dam a channel temporarily or accumulate behind temporary obstructions such as logs and forest debris.

Deer Winter Range
Locations that provide food and shelter for Sitka black-tail deer under moderately severe to severe winter conditions.

Degradation
The general lowering of the surface of the land by erosive processes, especially by the removal of material through erosion and transportation by flowing water.

Demographic
Pertaining to the study of the characteristics of human populations, such as size, growth, density, distribution, and vital statistics.

Detritis
Material, produced by the disintegration and weathering of rocks, that has been moved from its site of origin.

Developed Recreation
Recreation that requires facilities that, in turn, result in concentrated use of an area. Facilities in these areas might include roads, parking lots, picnic tables, toilets, drinking water, and buildings.

Direct Employment
The jobs that are immediately associated with the Long-Term Contract Timber Sale, including, for example, logging, sawmills, and pulpmills.

Discount Rate
The rate used to adjust future benefits or costs to their present value.

Dispersion
To disperse the effects of timber harvest by distributing harvest units more or less uniformly throughout a drainage so that increased runoff and sediment from disturbed sites will be buffered by lower levels of runoff and sediment production from surrounding undisturbed lands.

Dissected Landforms
A physical, recognizable form or feature of the earth's surface such as a mountain, hill, or valley having a characteristic shape, that in part is the result of several shallow or deeply incised drainage channels.

Dissolved Oxygen
The amount of free (not chemically combined) oxygen in water.

Distance Zone
Areas of landscapes denoted by specified distances from the observer (foreground, middleground, or background). Used as a frame of reference in which to discuss landscape characteristics of management activities.

Diversity
The distribution and abundance of different plant and animal communities and species within the area controlled by the Forest Plan.

Draft Environmental Impact Statement (DEIS)
A statement of environmental effects for a major Federal action which is released to the public and other agencies for comment and review prior to a final management decision. Required by Section 102 of the National Environmental Policy Act (NEPA).

Eagle Nest Tree Buffer Zone
A 330-foot radius around eagle nest trees established in an Agreement between the U.S. Fish and Wildlife Service and the Forest Service.

Ecosystem
A community of organisms and its physical setting. An ecosystem, whether a fallen log or an entire watershed, includes resident organisms, non-living components such as soil nutrients, inputs such as rainfall, and outputs such as organisms that disperse to other ecosystems.

Ecotone
A transition or junction zone between two or more naturally occurring diverse plant communities (ecosystems).

Ecotype
A species of plant or animal that displays different genetic or physiological adaptations. For example, the brown bear in Southeast Alaska is the same species as the grizzly bear in interior Alaska, but the brown bear is generally larger than the grizzly.

Effects
Effects, impacts, and consequences as used in this environmental impact statement are synonymous. Effects may be ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historical, cultural, economic, or social, and may be direct, indirect, or cumulative.

Direct Effects: Results of an action occurring when and where the action takes place.

Indirect Effects: Results of an action occurring at a location other than where the action takes place and/or later in time, but in the reasonably foreseeable future.

Cumulative Effects: See Cumulative Effects.

Encumbrance
A claim, lien, charge, or liability attached to and binding real property.

Endangered Species
Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act. See also, threatened species, sensitive species.

Environmental Analysis (EA)
A comprehensive evaluation of alternative actions and their predictable short-term and long-term environmental effects, which include physical, biological, economic, social, and environmental design factors and their interactions. An EA is less comprehensive than an Environmental Impact Statement (EIS), and may result in a Finding of No Significant Impact; should the EA reveal significant impacts, a full EIS must then be conducted.

Erosion
The wearing away of the land surface by running water, wind, ice, gravity, or other geological activities.

Escapement
Adult anadromous fish that escape from all causes of mortality (natural or human-caused) to return to streams to spawn.

Estuarine Fringe Use Area
A 1,000-foot timbered zone around an estuary.

Estuary
For the purpose of this EIS process, estuary refers to the relatively flat, intertidal, and upland areas generally found at the heads of bays and mouths of streams. They are predominately mud and grass flats and are unforested except for scattered spruce or cottonwood.

Even-Aged Management
The application of a combination of actions that result in the creation of stands in which trees of essentially the same age grow together. The difference in age between trees in forming the main canopy level of a stand usually does not exceed 20 percent of that age of the stand at harvest rotation age. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

Executive Order
An order or regulation issued by the President or some administrative authority under his or her direction.

Existing Visual Condition
The level of visual quality or condition presently occurring on the ground. The six existing visual condition categories are:

- *Type I:* Natural Condition. Areas in which only ecological change has taken place. Corresponds to the Preservation VQO.
- *Type II:* Natural appearing. Areas in which changes in the landscape are not noticed by the average forest visitor unless pointed out. Corresponds to the Retention VQO.
- *Type III:* Slightly altered. Areas in which changes in the landscape are noticed, but do not attract attention. Corresponds to the Partial Retention VQO.
- *Type IV:* Moderately altered. Areas in which changes in the landscape are easily noticed and may attract attention. Corresponds to the Modification VQO.
- *Type V:* Heavily altered. Areas in which changes in the landscape obviously appear to be major disturbances and stand out as a dominating impression of the landscape. Corresponds to the Maximum Modification VQO.
- *Type VI:* Drastically altered. Areas in which changes in the landscape are in glaring contrast to a natural appearance. Not a VQO.

Falldown (Hard and Soft Falldown)
The difference between planned or scheduled harvest and that which is attained after implementation is defined as Falldown. Hard Falldown occurs during harvest unit planning/design, layout, and during timber harvest and results in changes to the suitable timber base. Examples include previously unidentified small areas of poor soil stability, rock outcrops, v-notches, and small noncommercial forest sites. Soft Falldown occurs during harvest unit planning/design, layout, and occasionally during timber harvest and results in generally short-term deferrals (5-10 years) and typically do not affect the Forest Plan ASQ database.

Final Environmental Impact Statement (FEIS)
The final version of the statement of environmental effects required for major federal actions under Section 102 of the National Environmental Policy Act. It is a revision of the draft environmental impact statement (DEIS) to include public and agency responses to the draft. The decision maker chooses which alternative to select from the Final EIS, and subsequently issues a Record of Decision (ROD).

Fiscal Year (FY)
October 1 through September 30, e.g. October 1, 1992 - September 30, 1993 = FY93.

Floodplain
That portion of a river valley, adjacent to the river channel, which is covered with water when the river overflows its banks at flood stages.

Fluvial
Of or pertaining to streams and rivers.

Foreground
The stand of trees immediately adjacent to a scenic area, recreation facility, or forest highway; area located less than 1/4 mile from the viewer. See also, Background and Middleground.

Forest and Rangeland Renewable Resources Planning Act of 1976 (RPA)
Amended in 1976 by the National Forest Management Act. See RPA Assessment and Program.

Forest or Forest Land
National Forest lands currently supporting or capable of supporting forests at a density of 10 percent crown closure or better. Includes all areas with forest cover, including old growth and second growth, and both commercial and non-commercial forest land.

Forested Wetland
A wetland whose vegetation is characterized by an overstory of trees that are 20 feet or taller.

FORPLAN
The forest planning model. A linear programming software package used to analyze planning decisions regarding land use patterns, capital investment, and timber harvest scheduling.

FSH
Forest Service Handbook.

FSM
Forest Service Manual.

Geographic Information System (GIS)
An information processing technology to input, store, manipulate, analyze, and display spatial and attribute data to support the decision-making process. It is a system of computer maps with corresponding site specific information that can be electronically combined to provide reports and maps.

Geomorphology
The study of the forms of the land surface and the processes producing them. Also the study of the underlying rocks or parent materials and the landforms present which were formed in geological time.

Glide or Placid Streams
Grouping of channel types (L1 and L2) that have fairly consistent physical characteristics occurring on lowland landforms and are mostly associated with bogs, marshes, or lakes.

Groundwater
Water within the earth that supplies wells and springs.

Guideline
A preferred or advisable course of action or level of attainment designed to promote achievement of goals and objectives.

Habitat
The sum total of environmental conditions of a specific place occupied by an organism, population, or community of plants and animals.

Habitat Capability
The number of healthy animals that a habitat can sustain. Used in wildlife models to calculate rough population estimates for Management Indicator Species.

Habitat Improvement
Management of wildlife and fish habitat to increase their capability.

Hard Snags/Soft Snags
Hard snags are dead trees which have little decay and are generally still hard wood. Soft snags are dead trees which have a considerable amount of decay and are generally soft, broken wood.

Haul out
An area of large, smooth rocks used by seals and sea lions for resting and pupping.

Humus
Substance of organic origin that is fairly but not entirely resistant to further bacterial decay.

Hydrophyte
Plants typically found in wet habitats.

IMPLAN
A computer-based system used by the Forest Service for constructing nonsurvey input/output models to measure economic input. The system includes a data base for all counties in the United States and a set of computer programs to retrieve data and perform the computational tasks for input/output analysis.

Indirect Employment
The jobs in service industries that are associated with the Long-Term Contract timber sale including, for example, suppliers of logging and milling equipment.

Inoperable Timber
Timber that cannot be harvested by any proven method because of potential resource damage, extremely adverse economic considerations, or physical limitations.

Interdisciplinary Team (IDT)
A group of people with different backgrounds assembled to research, analyze, and write a project Environmental Impact Statement. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately analyze a proposed action and its alternatives.

Invertebrates
Animals without a backbone.

Irretrievable Commitments
Losses of production or use of renewable natural resources for a period of time. For example, timber production from an area is irretrievably lost during the time an area is allocated to a no-harvest prescription; if the allocation is changed to allow timber harvest, timber production can be resumed. The production lost is irretrievable, but is not irreversible.

Irreversible Commitments
Decisions causing changes which cannot be reversed. For example, if a roadless area is allocated to allow timber harvest and timber is actually harvested, that area cannot, at a later date, be allocated to wilderness. Once harvested, the ability of that area to meet wilderness criteria has been irreversibly lost. Often applies to nonrenewable resources such as minerals and cultural resources.

Issue
A point, matter, or section of public discussion or interest to be addressed or decided.

Knutsen-Vandenburg Fund (KV)
The portion of timber sale receipts collected and used for reforestation and other renewable resource projects on the sale area.

Land Allocation
The decision to use land for various resource management objectives to best satisfy the issues, concerns and opportunities and meet assigned forest output targets.

Land Exchange
The conveyance of non-Federal land or interests to the United States in exchange for National Forest System land or interests in land.

Land Use Designation (LUD)
The method of classifying land uses presented in the Tongass Land Management Plan (TLMP). Land uses and activities are grouped to define, along with a set of coordinating policies, a compatible combination of management activities. The following is a description of the four classifications:

- *LUD I:* Wilderness areas. Undeveloped areas managed for solitude and primitive types of recreation, and containing unaltered habitats for plant and animal species.
- *LUD II:* Lands to be managed in a roadless state in order to retain their wildland character; permits wildlife and fish habitat improvement as well as primitive recreation facility and road development under special authorization.
- *LUD III:* Lands to be managed for a variety of uses. The emphasis is on managing for uses and activities in a compatible and complimentary manner to provide the greatest combination of benefits.
- *LUD IV:* Lands that provide opportunities for intensive resource use and development where the emphasis is primarily on commodity or market resources.

Land Use Prescriptions
Specific management direction applied to a defined area of land to attain multiple use and other goals and objectives.

Landslides
The moderately rapid to rapid down slope movement of soil and rock materials that may or may not be water-saturated.

Large Woody Debris (LWD)
Any large piece of relatively stable woody material having a diameter of at least four inches and a length greater than three feet that intrudes into the stream channel. Also called Large Organic Debris (LOD).

Log Transfer Facility (LTF)
A facility that is used for transferring commercially harvested logs to and from a vessel or log raft, or the formation of a log raft. It is wholly or partially constructed in waters of the United States and location and construction are regulated by the 1987 Amendments to the Clean Water Act. Formerly termed "terminal transfer facility" or "log dump".

Logging Systems
Highlead: A cable yarding system, using a two-drum yarder, in which lead blocks are hung on a spar or tower to provide lift to the front end of the logs. Grabinski is a modified highlead cable system.

Aerial Logging Systems: Systems where the cut logs are moved from the stump to the loading area or log deck without touching the ground.

Live skyline/gravity carriage return: A two-drum, live skyline yarding system in which the carriage moves down the skyline by gravity; thus, is restricted to uphill yarding; the skyline is lowered to attach logs then raised and pulled to the landing by the mainline.

Live skyline/haulback required: A live skyline yarding system composed of skyline, mainline, and haulback; the carriage is pulled to the woods by the haulback; the skyline is lowered to permit the chokers to be attached to the carriage, and the turn is brought to the landing by the mainline.

Running skyline: A yarding system with three suspended moving lines, generally referred to as the main, haulback, and slack-pulling, that when properly tensioned will provide lift, travel, and control to the carriage; normally indicates a gantry type tower and a three-drum yarder.

Standing skyline: Used wherever yarding distances or span distances exceed the capability of live skyline equipment.

Multispan skyline: European equipment is commonly associated with this.

Tractor: Used to describe the full range of surface skidding equipment, designed to operate on level to downhill settings.

Shovel: A system of short-distance logging in which logs are moved from the stump to the landing by repeated swinging with a swing-boom log loader; the loader is walked off the haul road and out into the harvest unit; logs are moved and decked progressively closer to the haul road with each pass of the loader; when logs are finally decked at roadside, the same loader, or a different loader, loads out trucks. On gentle ground, logs are either heeled and swung or dragged by the boom as it rotates; larger log length and tree length logs are usually dragged to maintain machine stability. Soils should be moderate to well drained and side slopes must be less than 20 percent; passes or stripes should be kept to a maximum of four.

Helicopter: Flight path cannot exceed 40 percent downhill or 30 percent uphill; landings must be selected so there is adequate room for the operation and so that the helicopter can make an upwind approach to the drop zone.

A-Frame: Beach fringe timber which is logged with a float mounted yarder typically rigged in a highlead configuration for direct A-frame yarding.

Cold-deck and swing: Planned to access areas not suitable for skyline operations.

MBF
A thousand board feet net sawlog and utility volume.

MMBF
A million board feet net sawlog and utility volume.

MMCF
A million cubic feet net sawlog and utility volume.

Management Area
An area one or more VCUs in size for which management direction was written in the Tongass Land Management Plan.

Management Indicator Species (MIS)
Species selected in a planning process that are used to monitor the effects of planned management activities on viable populations of wildlife and fish, including those that are socially or economically important.

Management Prescriptions
Method of classifying land uses presented in the Tongass Land Management Plan (TLMP) Revision DEIS. Replaces the Land Use Designations (LUDs) originally presented in TLMP.

Management Requirement
Standards for resource protection, vegetation manipulation, silvicultural practices, even-aged management, riparian areas, soil and water and diversity, to be met in accomplishing National Forest System goals and objectives. (see 36 CFR 219.17)

Mass Failure
The downslope movement of a block or mass of soil. This usually occurs under conditions of high-soil moisture and does not include individual soil particles displaced as surface erosion.

Maritime Climate
Weather conditions controlled by an oceanic environment characterized by small annual temperature ranges and high precipitation.

McGilvery (Soil series)
Soil series which represents the only well-drained organic soil found in the Ketchikan Area. It is composed of a thin surface layer (less than 8 inches deep) of organic material overlying bedrock. These soils are associated with cliffs and rock outcrops, and are sensitive to disturbance.

Mean Annual Increment (MAI)
The total volume of a stand divided by its age.

Memorandum of Understanding (MOU)
A legal agreement between the Forest Service and others agencies resulting from consultation between agencies that states specific measures the agencies will follow to accomplish a large or complex project. A memorandum of understanding is not a fund obligating document.

Microclimate
The temperature, moisture, wind, pressure, and evaporation (climate) of a very small area that differs from the general climate of the larger surrounding area.

Middleground
The visible terrain beyond the foreground where individual trees are still visible but do not stand out distinctly for the landscape; area located from 1/4 to 5 miles from the viewer. See also, Foreground and Background.

Mineral Soils
Soils consisting predominately of, and having its properties determined by, mineral material.

Minimum Viable Population
A population with the estimated numbers and distribution of reproductive individuals to maintain the population over time.

Mining Claims
A geographic area of the public lands held under the general mining laws in which the right of exclusive possession is vested in the locator of a valuable mineral deposit.

Mitigation
Measures designed to counteract environmental impacts or to make impacts less severe. These may include: avoiding an impact by not taking a certain action or part of an action; minimizing an impact by limiting the degree or magnitude of an action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or compensating for the impact by replacing or providing substitute resources or environments.

Mixed Conifer
In Southeast Alaska, mixed conifer stands usually consist of western hemlock, mountain hemlock, Alaska yellowcedar, Western redcedar, and Sitka spruce species. Shorepine may occasionally be present depending on individual sites.

Model
A representation of reality used to describe, analyze, or understand a particular concept. A model may be a relatively simple qualitative description of a system or organization, or a highly abstract set of mathematical equations. A model has limits to its effectiveness, and is used as one of several tools to analyze a problem.

Monitoring
A process of collecting information to evaluate whether or not objectives of a project and its mitigation plan are being realized. Monitoring can occur at different levels: to confirm whether mitigation measures were carried out in the manner called for, to determine whether the mitigation measures were effective, or to validate whether overall goals and objectives were appropriate. Different levels call for different methods of monitoring.

Multi-entry Layout Process (MELP)
Computerized data base located in each area supervisor's office containing information on timber, transportation, and TLMP management goals. It is used for planning and economic analyses for the Forest Service administrative area.

Multiple-aged Stands
An intermediate form of stand structure between even and uneven-aged stands. These stands generally have two or three distinct tree canopy levels occurring within a single stand.

Multiple Use
The management of all the various renewable resources of the National Forest System to be used in the combination that will best met the needs of the American people.

Muskeg
In Southeast Alaska a type of bog that has developed over thousands of years in depressions or flat areas on gentle to steep slopes. Also called peatlands.

Mycorrhizae
A mutualism between plant roots and certain kinds of fungi. The plants exude carbon compounds to the fungi and the fungi provide the plants with soil nutrients, such as phosphorus.

National Environmental Policy Act (NEPA) of 1969
An Act to declare a national policy which will encourage productive and enjoyable harmony between humankind and the environment, to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, to enrich the understanding of the ecological systems and natural resources important to the Nation, and to establish a Council on Environmental Quality (The Principal Laws Relating to Forest Service Activities, agric. Handb. 453. USDA Forest Service, 359 p.).

National Forest Management Act (NFMA)
A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act requiring the preparation of Regional Guides and Forest Plans and the preparation of regulations to guide that development.

National Wild and Scenic River System
Rivers with outstanding scenic, recreational, geological, fish and wildlife, historic, cultural, or other similar values designated by Congress under the Wild and Scenic Rivers Act of 1968 and amended in 1986, for preservation of their free-flowing condition. May be classified and administered under one or more of the following categories: Wild, Scenic, and/or Recreational.

Native Allotment
A tract of non-mineral land, not to exceed 160 acres, on which an Alaska Native (who was 21 year of age or head of a household) established continuous use and occupancy prior to the creation of the National Forests (authorized under the Native Allotment Act of May 17, 1906).

Native Selection
Application by Native corporations and individuals to a portion of the USDI Bureau of Land Management for conveyance of lands withdrawn in fulfillment of Native entitlements established under ANSCA.

Net Sawlog Volume
Tree or log volume suitable in size and quality to be processed into lumber. In Southeast Alaska, depending on the market, the volume may be processed as pulp or lumber.

No-action Alternative
The most likely condition expected to exist in the future if current management direction were to continue unchanged.

Non-commercial Forest Land
Land with more than 10 percent cover of commercial tree species but not qualifying as Commercial Forest land.

Noncommercial species
Species that have no economic values at this time nor anticipated timber value within the near future.

Nondeclining Even Flow
A policy governing the volume of timber removed from a National Forest, which states that the volume planned for removal in each succeeding decade will equal or exceed that volume planned for removal in the previous decade.

Non-Forest Land
Land that has never supported forests and lands formerly forested but now developed for such nonforest uses as crops, improved pasture, etc.

Notice of Intent (NOI)
A notice printed in the Federal Register announcing that an Environmental Impact Statement will be prepared. The NOI must describe the proposed action and possible alternatives, describe the agency's proposed scoping process, and provide a contact person for further information.

Objectives
The precise steps to be taken and the resources to be used in achieving goals.

Offering
A Forest Service specification of timber harvest units, subdivisions, roads, and other facilities and operations to meet the requirements of a contract.

Offering Area
A geographic area identified by the Forest Service within which the offering specifications are outlined. One or more offering areas may be identified within all or a portion of an a project area.

Old Growth
Ecosystems distinguished by old trees and related structural attributes. Old-growth forests are characterized by larger tree size, higher accumulations of large dead woody material, multiple canopy layers, different species composition, and different ecosystem function. The structure and function of an old-growth ecosystem will be influenced by its stand size and landscape position and context. For the displays in this project, it is those areas typed as Volume Class 4, 5, 6, and 7.

Organic Soils
Soils that contain a high percentage (generally greater than 20 to 30 percent) of organic matter throughout the soil depth.

Parent Material
The unconsolidated and partially weathered material (or the C Horizon) from which upper layers of soil developed.

Partial Cut
Method of harvesting trees where any number of live stems are left standing in any of various spatial patterns. Not clearcutting. Can include seed tree, shelterwood, or other methods.

Patch
A non-linear surface area differing in appearance from its surroundings.

Payments to States
A fund consisting of approximately 25 percent of the gross annual timber receipts received by the National Forests in that state. This is returned to the State for use on roads and schools.

Peak flow
The highest discharge of water recorded over a specified period of time at a given stream location. Often thought of in terms of spring snowmelt, summer, fall, or winter rainy season flows. Also called maximum flow.

pH
The degree of soil acidity or alkalinity.

Planning Area
The area of the National Forest System controlled by a decision document.

Planning Record
A system that records decisions and activities that result from the process of developing a forest plan, revision, or significant amendment.

Plant Association
Climax plant community type.

Plant Communities
Aggregations of living plants having mutual relationships among themselves and to their environment. More than one individual plant community.

Pole
An immature tree between 5 and 9 inches diameter breast height.

Potential Yield
The maximum, perpetual, sustained-yield harvest attainable through intensive forestry on regulated areas considering the productivity of the land, conventional logging technology, standard cultural treatments, and interrelationships with other resource uses and the environment.

Present Net Value (PNV)
The difference between the benefits and costs associated with the alternatives.

Prescribed Fire
A wildland fire burning under planned conditions to accomplish specific land and resource objectives. It may result from either a management or natural ignition.

Primary Stream Production
Results from photosynthesis by green plants. In streams, includes production from algae and aquatic plants, and from non-stream sources such as leaf litter.

Primary Succession
Vegetation development is initiated on newly formed soils or upon surfaces exposed for the first time (as by landslides) which have, as consequence, never borne vegetation before.

Process Group
A combination of similar channel types based on major differences in landform, gradient, and channel shapes.

Proportionality
The Tongass Timber Reform Act (TTRA 1990) modification of Alaska's Long-Term Timber Sale Contracts to eliminate the practice of harvesting a disproportionate amount of old-growth timber.

Public Participation
Meetings, conferences, seminars, workshops, tours, written comments, responses to survey questionnaires, and similar activities designed and held to obtain comments from the public about Forest Service activities.

Receipts
Those priced benefits for which money will actually be paid to the Forest Service: recreation fees, timber harvest, mineral leases, and special use fees.

Record of Decision
A document separate from but associated with an Environmental Impact Statement which states the decision, identifies all alternatives, specifying which were environmentally preferable, and states whether all practicable means to avoid environmental harm from the alternative have been adopted, and if not, why not.

Recreation Opportunity Spectrum (ROS)
Land delineations that identify a variety of recreation experience opportunities categorized into eight classes on a continuum from primitive to urban. Each class is defined in terms of the degree to which it satisfies certain recreation experience needs based on the extent to which the natural environment has been modified, the type of facilities provided, the degree of outdoor skills needed to enjoy the area and the relative density of recreation use. The eight classes are:

Primitive I: Includes areas out of sight and sound of human activities and greater than 3 miles from roads open to public travel and marine travel ways. Provides opportunities for a high-degree of interaction with the natural environment, challenge, risk, and the use of outdoor skills.

Primitive II: Area is similar in appearance to Primitive I ROS class; however, it is accessible by marine travel way or is within 1/4 mile of low-use trails.

Semi-Primitive Nonmtorized: Includes areas greater than 1/4 mile and less than 3 miles from all roads, trails, or readily accessible marine travel ways. Provides limited opportunities for isolation from the sights and sounds of humans and a high-degree of interaction with the natural environment. Moderate challenge, risk, and the opportunity to use outdoor skills.

Semi-Primitive Motorized: Includes areas less than 1/4 mile from primitive roads, trails, or readily accessible marine travel ways. Characterized by a predominately unmodified natural environment with minimum evidence of sights and sounds of humans. Road access is not maintained in these areas.

Roaded Natural: Areas are less that 1/4 mile from roads open to public travel, major power lines, and areas of timber harvest. Areas are characterized by predominantly natural environments with moderate evidence of sights and sounds of humans.

Roaded Modified: Areas are less than 1/4 mile from areas of timber harvest and transportation corridors. Areas are characterized by substantially modified natural environments. Sights and sounds of humans are readily evident.

Rural: Includes those areas with small communities, developed campgrounds, and administrative sites. These areas are characterized by substantially modified natural environments. Sights and sounds of humans are readily evident.

Urban: Areas characterized by substantially urbanized environment. The background may have elements of a natural environment. Timber harvest activities and utilization

practices are common. Sights and sounds of humans predominant. Large numbers of visitors can be expected on site and in nearby areas.

Reforestation
The natural or artificial restocking of an area with trees.

Regeneration
The process of establishing a new crop of trees on previously harvested land.

Regional Forester
The Forest Service official responsible for administering a single region.

Regional Guide
The guide developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974 as amended. It guides all natural resource management activities and establishes management standards and guidelines for the National Forest System lands within a given region.

Rehabilitation
Actions taken to protect or enhance site productivity, water quality, or other values for a short period of time.

Reserved Lands
Lands reserved from the public domain for National Forest purposes and lands which are added to the National Forest System by exchange for reserved National Forest lands.

Resident Fish
Fish that are not anadromous and that reside in freshwater on a permanent basis. Resident fish include non-anadromous Dolly Varden char and cutthroat trout.

Resource values
The tangible and intangible worth of forest resources.

Responsible Official
The Forest Service employee who has the delegated authority to make a specific decision.

Restricted Harvest
The action of apportioning the supply of a resource to specific uses or to particular persons or organizations.

Restoration
The long-term placement of land back into its natural condition or state of productivity.

Retention Factor
The amount of commercial forest land removed from the calculation of the ASQ as an allowance to protect other resource values. These factor allowances available to draw upon when meeting other resource needs and are not fixed policies to be rigidly applied by the interdisciplinary team or Forest supervisors.

Revegetation
The re-establishment and development of a plant cover. This may take place naturally through the reproductive processes of the existing flora or artificially through the direct action of reforestation or reseeding.

Riparian Area
Geographically delineable area with distinctive resource values and characteristics that contain elements of aquatic and riparian ecosystems.

Riparian Ecosystem
Land next to water where plants that are dependent on a perpetual source of water occur.

Roads
Arterial: Roads usually developed and operated for long-term land and resource management purposes to constant service.
Collector: Collects traffic from Forest local roads; usually connects to a Forest arterial or public highway.
Local: Provides access for a specific resource use activity such as a timber sale or recreational site, although other minor uses may be served.
Preplanned: Roads planned in a prior EIS.
Temporary: For National Forest timber sales, temporary roads are constructed to harvest timber on a one-time basis. These logging roads are not considered part of the permanent Forest transportation network and have stream crossing structures removed, erosion measures put into place, and the road closed to vehicular traffic after harvest is completed.

Roadless Area
An area of undeveloped public land within which there are no improved roads maintained for travel by means of motorized vehicles intended for highway use.

Rotation
The planned number of years (approximately 100 years in Alaska) between the time that a Forest stand is regenerated and its next cutting at a specified stage of maturity.

Rotation Age
The age of a stand when harvested at the end of a rotation.

RPA Assessment and Program
The RPA Assessment is prepared every ten years and describes the potential of the nation's forests and rangelands to provide a sustained flow of goods and services. The RPA Program is prepared every five years to chart the long-term course of Forest Service management of the National Forests, assistance to State and private landowners, and research. They are prepared in response to Sections 3 and 4 of the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) (16 U.S.C. 1601).

Salvage Sale
A timber sale to use dead and down timber and scattered poor-risk trees that would not be marketable if left in the stand until the next scheduled harvest.

Sawlog
That portion of a tree that is suitable in size and quality for the production of dimension lumber collectively known as sawtimber.

Scheduled Lands
Land suitable and scheduled for timber production and which are in the land base for the calculation of the allowable sale quantity and long-term sustained yield timber capacity.

Scheduled Timber Harvests
Timber harvests done as part of meeting the allowable sale quality.

Scoping Process
Early and open activities used to determine the scope and significance of a proposed action, what level of analysis is required, what data is needed, and what level of public participation is appropriate. Scoping focuses on the issues surrounding the proposed action, and the range of actions, alternatives, and impacts to considered in an EA or an EIS.

Scrub-Shrub Wetland
Wetlands dominated by woody vegetation less than 20 feet tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. In Southeast Alaska this includes forested lands where trees are stunted because of poor soil drainage.

Second Growth
Forest growth that has become established following some disturbance such as cutting, serious fire, or insect attack; even-aged stands that will grow back on a site after removal of the previous timber stand.

Secondary Stream Production
Results from consumption by animals of materials produced in primary production in streams; this includes production of macroinvertebrates and some fish species.

Secondary Succession
The process of re-establishing vegetation after normal succession is disrupted by fire, cultivation, lumbering, windthrow, or any similar disturbance.

Sediment
Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earth's surface.

Seed Tree
Small number of seed-bearing trees left singly or in small groups after timber harvest to provide seed for regeneration of the site.

Selective Cutting
The annual or periodic removal of trees (particularly the mature), individually or in small groups from an uneven-aged forest to achieve the balance among diameter classes needed for sustained yields, and in order to realize the yield, and establish a new crop of irregular constitution. Note: The improvement of the Forest is a primary consideration.

Sensitive Species
Plant and animal species which are susceptible or vulnerable to activity impacts or habitat alterations. Those species that have appeared in the Federal Register as proposed for classification or are under consideration for official listing as endangered or threatened species, that are on a non-official State list, or that are recognized by the regional forester as needing special management to prevent placement on Federal or state lists.

Sensitivity Level

A map inventory that measures peoples' concern for the scenic quality of the National Forests. In 1980, the Tongass National Forest assigned sensitivity levels to land areas viewed from anchorages, plane and boat routes, roads, trails, public-use areas, and recreation cabins.

Level I: Includes all seen areas from primary travel routes, use areas, and water bodies where at least three-fourths of the Forest visitors have a major concern for scenic quality.

Level II: Includes all seen areas from primary travel routes, use areas, and water bodies where at least one-fourth of the Forest visitors have a major concern for scenic quality.

Level III: Includes all seen areas form secondary travel routes, use areas, and water bodies where less than one-fourth of the Forest visitors have a major concern for scenic quality.

Seral

Early stage of succession.

Shelterwood Cutting

A harvest method in which most of the trees are removed in an initial entry and some trees are left to naturally reseed the area and provide protection to new seedlings that establish on the site. A second entry is conducted later to remove the remaining trees.

Silviculture

The science of controlling the establishment, composition, and growth of forests.

Single-tree selection

A cutting method to develop and maintain uneven-aged stands by removal of selected trees from specified age classes over the entire stand area in order to meet a predetermined goal of age distribution and species in the remaining stand.

Site Index

A measure of the relative productive capacity of an area for growing wood. Measurement of site index is based on height of the dominant trees in a stand at a given age.

Site Preparation

Manipulation of the vegetation or soil of an area prior to planting or seeding. The manipulation follows harvest, wildfire, or construction in order to encourage the growth of favored species. Site preparation may include the application of herbicides, burning, or cutting of living vegetation that competes with the favored species; tilling the soil; or burning of organic debris (usually logging slash) that makes planting or seeding difficult.

Site Productivity

Production capability of specific areas of land.

Slope Distance

Distance measured along the contour of the ground.

Smolt

Young silvery-colored salmon or trout which move from freshwater streams to saltwater.

Snag

A standing dead tree, usually greater than 5 feet tall and 6 inches in diameter at breast height.

Soil Productivity
The capacity of a soil, in its normal environment, to produce a specific plant or sequence of plants under a specific system of management.

Soil Quality Standards
Standards that are a combination of 1) "threshold" values for severity of soil property alteration, or significant change in soil properties conditions, and 2) areal extent of disturbance.

Soil Resource Inventory (SRI)
An inventory of the soil resource based on landform, vegetative characteristics, soil characteristics, and management potentials.

Special Habitats
Structural elements of ecosystems. These may include, but are not limited to: snags, spawning gravels, fallen trees, aquatic reefs, caves, seeps, and springs.

Special Use Authorization
A permit, term permit, temporary permit, lease, or easement that allows occupancy or use of, or rights and privileges on National Forest System lands.

Special Use Permit
Permits and granting of easements (excluding road permits and highway easements) authorizing the occupancy and use of land.

Specify
"Specify" means to approve an Offering in writing by issuance of an A Division for the Offering, for implementation in conformance with the other requirements of the contract.

Split Yarding
The process of separating the direction of timber harvest yarding into opposite directions.

Stand (Tree Stand)
An aggregation of trees occupying a specific area and sufficiently uniform in composition, age arrangement, and condition as to be distinguishable from the forest in adjoining areas.

Standard
A course of action or level of attainment required by the forest plan to promote achievement of goals and objectives.

State Historic Preservation Officer (SHPO)
State appointed official who administers Federal and State programs for cultural resources.

State Selection
Application by Alaska Department of Natural Resources to the USDI Bureau of Land Management for conveyance of a portion of the 400,000 acre State entitlement from vacant and unappropriated National Forest System lands in Alaska, under the Alaska Statehood Act of 1959 (Public Law 85-508, 72 Stat. 340).

Stocking
The degree of occupancy of land by trees as measured by basal area or number of trees and as compared to a stocking standard; that is, the basal area or number of trees required to fully use the growth potential of the land.

Stream Classes
See Aquatic Habitat Management Unit.

Stream Order
First order streams are the smallest unbranched tributaries; second order streams are initiated by the point where two first order streams meet; third order streams are initiated by the point where two second order streams meet, and so on.

Structural Diversity
The diversity of forest structure, both vertically and horizontally, which provides for a variety of forest habitats such as logs and multi-layered forest canopy for plants and animals.

Stumpage
The value of timber as it stands uncut in terms of dollar value per thousand board feet.

Subsistence
Section 803 of the Alaska National Interest Lands Conservation Act defines subsistence use as, "the customary and traditional uses by rural Alaska residents of wild renewable resources for direct, personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."

Subsistence Use Area
Important Subsistence Use Areas include the "most reliable" and "most often hunted" categories from the Tongass Resource Use Cooperative Survey (TRUCS) and from subsistence survey data from ADF&G, the University of Alaska, and the Forest Service, Region 10. Important use areas include both intensive and extensive use areas for subsistence harvest of deer, furbearers, and salmon.

Substantive Comment
A comment that provides factual information, professional opinion, or informed judgement germane to the action being proposed.

Substrate
The type of material in the bed (bottom) of rivers and streams.

Succession
The ecological progression of community change over time, characterized by displacements of species leading towards a stable climax community.

Suitable
Commercial Forest land identified as having both the biological capability and availability to produce industrial wood products.

Suitable Forest land
Forest land for which technology is available that will ensure timber production without irreversible resource damage to soils, productivity, or watershed conditions, and for which there is reasonable assurance that such lands can be adequately restocked, and for which there is management direction that indicated that timber production is an appropriate use of that area.

Suspended Sediment
The very fine soil particles which remain in suspension in water for a considerable period of time without contact with the stream or river channel bottom.

Sustained Yield
The amount of renewable resources that can be produced continuously at a given intensity of management.

Swale
A slight, marshy depression in generally level land. A depression in glacial ground moraine.

Tentatively Suitable Forest Land
Forest land that is producing or is capable of producing crops of industrial wood and: (a) has not been withdrawn by Congress, the Secretary of Agriculture of the Chief of the Forest Service; (b) existing technology and knowledge is available to ensure timber production without irreversible damage to soils productivity, or watershed conditions; (c) existing technology and knowledge, as reflected in current research and experience, provides reasonable assurance that it is possible to restock adequately within 5 years after final harvest; and (d) adequate information is available to project responses to timber management activities.

Terrestrial Ecosystems
Plant communities that are not dependent on a perpetual source of water to grow.

Thinning
The practice of removing some of the trees in a stand so that the remaining trees will grow faster due to reduced competition for nutrients, water, and sunlight. Thinning may also be done to change the characteristics of a stand or wildlife or other purposes. Thinning may be done at two different stages.

Threatened Species
Plant or animal species which is likely to become endangered throughout all or a significant portion of its range within the foreseeable future, as defined in the Endangered Species Act of 1973, and which has been designated in the Federal Register by the Secretary of the Interior as a threatened species. (See also, endangered species, sensitive species.)

Threshold
The point or level of activity beyond which an undesirable set of responses begins to take place within a given resource system.

Tiering
Eliminating repetitive discussions of the same issue by incorporating by reference. The general discussion in an environmental impact statement of broader scope; e.g., this document is tiered to the Tongass Land Management Plan, as amended.

Timber Appraisal
Establishing the fair market value of timber by taking the selling value minus manufacturing costs, the cost of getting logs from the stump to the manufacturer, and an allowance for profit and risk.

Timber Classification
Forested land is classified under each of the land management alternatives according to how it relates to be management of the timber resource. The following are definitions of timber classifications used for this purpose.

Nonforest: Land that has never supported forests and land formerly forested where use for timber production is precluded by development or other uses.

Forest: Land at least 10-percent stocked (based on crown cover) by forest trees of any size, or formerly having had such tree cover and not currently developed for nonforest use.

Suitable or suitable available: Land to be managed for timber production on a regulated basis.

Unsuitable: Forest land withdrawn from timber utilization by statute or administrative regulation (for example, wilderness), or identified as inappropriate for timber production in the Forest planning process.

Commercial forest: Forest land tentatively suitable for the production of continuous crops of timber and that has not been withdrawn.

Timber Dispersion
When an opening created from a final timber harvest is no longer considered an opening for the purpose of scheduling adjacent timber harvest. This is often expressed as the maximum amount of disturbance in a watershed at any given time.

Timber Harvest Unit
A "Timber Harvest Unit" is a portion of an Offering Area within which Forest Service specifies for harvest all or part of the timber to meet the requirements of this contract [KPC] and designates as Included Timber under B2.3.

Timber Stand Improvement (TSI)
All noncommercial intermediate cutting and other treatments to improve composition, condition, and volume growth of a timber stand.

Tongass Land Management Plan (TLMP)
The 10-year land allocation plan for the Tongass National Forest that directs and coordinates planning, the daily uses, and the activities carried out within the forest. Currently under revision.

Tongass Resource Use Cooperative Survey (TRUCS)
A study on subsistence uses which was used for evaluating the effects of the proposed action in this EIS.

Turbidity
An indicator of the amount of sediment suspended in water.

Understory
The trees and shrubs in a forest growing under the canopy or overstory.

Uneven-Aged Management
Forest management techniques which simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes. Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes.

Unscheduled Lands
Lands suitable but not scheduled for timber production and which are not in the land base for the calculation of the allowable sale quantity nor long-term sustained yield timber capacity.

Unsuitable
Forest land withdrawn from timber utilization by statute or administrative regulation; for example, wilderness, or identified as not appropriate for timber production in the forest planning process.

Utility Logs
Those logs that do not meet sawlog grade but are suitable for production of firm useable pulp chips.

VAC
See Visual Absorption Capability.

Value Comparison Unit (VCU)
Areas which generally encompass a drainage basin containing one or more large stream systems; boundaries usually follow easily recognizable watershed divides. Established to provide a common set of areas where resource inventories could be conducted and resource interpretations made.

Viable Population
A population with the estimated numbers and distribution of reproductive individuals to maintain the population over time.

Viewshed
An expansive landscape or panoramic vista seen from a road, marine water way, or specific viewpoint.

Visual Quality Objectives (VQO)
Measurable standards reflecting five different degrees of landscape alteration based upon a landscape's diversity of natural features and the public's concern for high scenic quality. The five categories of VQOs are:

Preservation: Permits ecological changes only. Applies to wilderness areas and other special classified areas. Management activities are generally not allowed in this setting.

Retention: Provides for management activities that are not visually evident to the casual Forest visitor.

Partial Retention: Management activities remain visually subordinate to the natural landscape.

Modification: Management activities may visually dominate the characteristics landscape. However, activities must borrow from naturally established form-line color and texture so that the visual characteristics resemble natural occurrences within the surrounding area when viewed in the middleground distance.

Maximum Modification: Management activities may dominate the landscape but should appear as a natural occurrence when viewed as background.

V-Notches
A deeply incised valley along some waterways that would look like a "V" from a cross-section. These abrupt changes in terrain features are often used as harvest unit or yarding boundaries.

Volume
Stand volume based on standing net board feet per acre by Scribner Rule.

Volume Class
Used to describe the average volume of timber per acre in thousands of board feet (MBF). The seven volume classes include:

Classes 1 to 3: Less than 8 MBF/acre (cleared land, seedlings, or pole timber stands).
Class 4: 8 to 20 MBF/acre.
Class 5: 20 to 30 MBF/acre.
Class 6: 30 to 50 MBF/acre.
Class 7: 50+ MBF/acre.

Watershed
The area that contributes water to a drainage or stream. Portion of the forest in which all surface water drains to a common point. Watersheds can range from a few tens of acres that drain a single small intermittent stream to many thousands of acres for a stream that drains hundreds of connected intermittent and perennial streams.

Wetland
Areas that are inundated by surface or groundwater frequently enough to support vegetation that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include: swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mudflats, and natural ponds. See the TLMP Draft Revision pgs. 3-423 and 3-424 for detailed discussion on wetland type definitions.

Wilderness
Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped federal land retaining its primeval character and influence without permanent improvements or humans habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature, with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or a primitive and unconfined type of recreation; areas of at least 5,000 acres are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, educational, scenic, or historical value as well as ecologic and geologic interest. In Alaska, Wilderness has been designated by ANILCA and TTRA.

Wildlife Analysis Area (WAA)
A division of land used by the Alaska Department of Fish and Game for wildlife analysis.

Wildlife Habitat
The locality where a species may be found and where the essentials for its development and sustained existence are obtained.

Wildlife Habitat Management Unit (WHMU)
An area of wildlife habitat identified during the IDT process as having values important to wildlife.

Windfirm
Trees that have been exposed to the wind throughout their life and have developed a strong root system or trees that are protected from the wind by terrain features.

Windthrow
The act of trees being uprooted by the wind. In Southeast Alaska, Sitka spruce and hemlock trees are shallow rooted and susceptible to windthrow. There generally are three types of windthrow:

Endemic: where individual trees are blown over;
Catastrophic: where a major windstorm can destroy hundreds of acres; and
Management Related: where the clearing of trees in an area make the adjacent standing trees vulnerable to windthrow.

Winter Range
An area, usually at lower elevation, used by big game during the winter months; usually smaller and better-defined than summer ranges.

Withdrawal
The withholding of an area of Federal land from settlement, sale, location, or entry under some or all of the general land laws for the purpose of limiting activities under those laws in order to maintain other public values in the area.

Yarding
Hauling timber from the stump to a collection point.

Yield Tables
Tables that estimate the level of outputs that would result from implementing a particular activity. Usually referred to in conjunction with FORPLAN input or output. Yield tables can be developed for timber volumes, range production, soil and water outputs, and other resources.

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Michael Blandov
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